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Magnetic Superhardening and Stabilization of Metals

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Practical results may be said to be these: Cutting tools of many types and shapes may be superhardened at slight expense in equipment and labor, and small wearing surfaces of machinery can be made more satisfactory, probably permitting the substitution of lower grade materials. In his third article in *A. M.* in recent years, the author unfolds a new theory of magnetic stabilization of metals at hardness levels considerably in excess of that induced by quenching or work hardening.

SUPERHARDENING of metals was stumbled upon by the Egyptians and patiently striven for by the armorers of Toledo, but complete scientific knowledge concerning it still tempts present descendants of Vulcan. Heat-treatment and work hardening have been extensively investigated in recent years. The latter process is carried out in various ways, but the "Cloudburst" method of bombardment with steel balls (*AM*—Vol.72, p. 917) brought out a curious fact. It was found that a spontaneous increase in hardness occurred after cessation of the bombardment, and that this continued for several hours. Atomic rearrangement within the metal was thought to be the cause of the phenomenon. To hasten this rearrangement a magnetic treatment was applied (*AM* — Vol. 74, p.967). Very complicated hardness changes ensued, pointing most convincingly to the atomic character of the disturbances. Additional experiments, to be discussed in this article, have brought the whole subject directly into the sphere of the shop man, since they show that the additional hardness induced in hardened steel by magnetic treatment can be stabilized and made use of through a second magnetic treatment applied according to the theory developed.

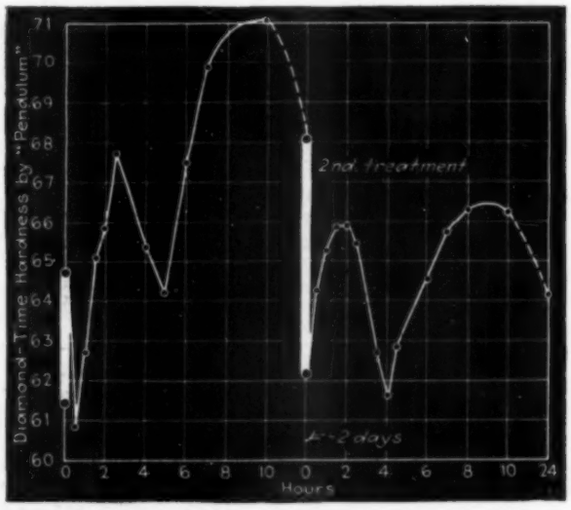


Fig. 1—Wide variations in hardness of a razor blade follow rotating it in a magnetic field. Periodic character of swings indicates disturbance of atomic system

Before discussing the concepts leading to the theory of magnetic superhardening and stabilization of hardness in metals, the results of the initial magnetic treatment should be summarized: The magnetically treated steel went through a cycle of changes, comprising periods of alternate softening and hardening during many hours, and when the fluctuations finally ceased, they could be started up afresh by a repetition of the rotary magnetic treatment. It was further found that analagous hardness fluctuations could be induced by rotary magnetic treatment in steel which had been hardened by quenching only, in soft steels and in non-magnetic metals such as brass and duralumin.

The actual character of the atomic changes referred to was deduced by experiments illustrated in Fig. 1. A razor blade was placed across the poles of an electro-magnet and rotated 1¼ turns. The hardness was measured with the Herbert Pendulum Hardness Tester and was

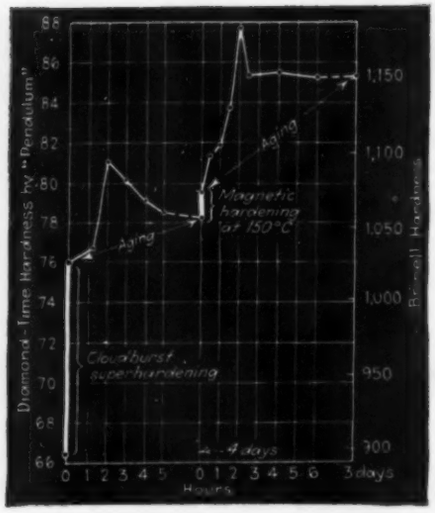


Fig. 2 — Fluctuations in hardness of cobalt high-speed steel, as set up either by the "Cloudburst" process or the rotary magnetic process, are similar, and they persist until damped out after many hours

found to have increased from 61.4 to 64.7 diamond-time hardness. Half an hour later the hardness had fallen below the original value. Continued half-hour measurements showed a series of six alternating changes during two days. During this time the successive maxima and minima progressively increased from a half-hour to 38-hour intervals. Repetition of the magnetic treatment caused five alternating changes, which took place at gradually increasing intervals. This curve, which has since been reproduced on a variety of metals, indicates that the changes are periodic in character, and can only be attributed to something in the metal either rotating or oscillating at a gradually decreasing speed.

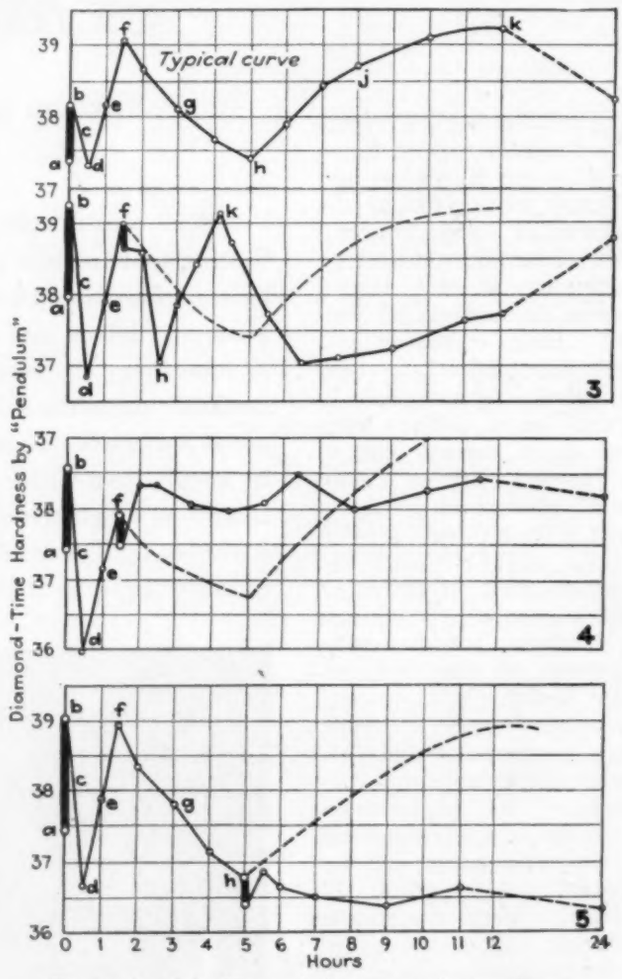
Correlation of this and other data then showed: First, the fluctuations in hardness set up by the Cloudburst superhardening process were found to resemble those produced by the rotary magnetic treatment. This is shown by Fig. 2. Second, it was found that somewhat similar fluctuations of hardness occurred in the soft non-ferrous metals, brass and duralumin, as the result of a simple cold-working process. Third, it was found that the spontaneous increase in hardness, which takes place during the aging of freshly quenched tool steel, is not a simple hardening but the first of a cycle of alternating changes comprising both hardening and softening.

The accumulated evidence pointed to the fact that any violent atomic disturbance—mechanical, thermal, or magnetic—is likely to set a given metal in a state of oscillation or periodic fluctuation characterized by alternate increases and decreases of hardness, persisting for many hours, the successive changes slowing down and gradually damping out to virtual stability.

These periodic fluctuations were evidently due to a periodic movement, rotation or vibration occurring in the atoms of the mass, but how was this to be proved? It seemed probable that a violent magnetic disturbance, such as that caused by the rotary magnetic field, would affect the speed or the orbits of the electrons in the atoms, and that the observed fluctuations in hardness might thus be accounted for. But whereas the hardness fluctuations have a periodicity of a few minutes increasing to many hours, the speed of the electrons is in billions of revolutions per second. An analogy can be drawn from the gyroscope or from a school-boy's top.

If a rapidly spinning gyroscope has the axis displaced from the vertical, at once the axis begins to move quite slowly in a conical path. If the gyroscope is slowed down, the conical movement of the axis becomes more rapid, this movement being known as "precession." In the gyroscope we thus have two rotary movements, spin and precession, which are so related that a slow rate of spin coincides with a rapid rate of precession, and vice versa. If the process could be reversed, the rate of spin would be gradually increased to a very high value, and the rate of precession should become extremely slow and thus pass through some such periodicities as those of the hardness changes in Fig. 1.

Means were devised for testing the "precession" theory. It was known that if the rotary magnetic treatment was applied under carefully standardized conditions to precisely similar specimens, the resulting cycle of hardness fluctuations would repeat itself with great precision. This is seen in the typical curve for Figs. 3, 4 and 5, which show the result of a standardized magnetic treatment on specimens of hard drawn steel wire. The specimen was placed in the magnet gap so that the lines of force passed through it transversely, and it was given one complete turn in exactly 40 seconds. Half-



Figs. 3, 4 and 5—The typical curve at the top shows the hardness changes induced in hard-drawn steel wire by rotating it one turn in 40 sec. in a magnetic field at point "a." The fluctuations in hardness were accelerated, Fig. 3, by a second identical magnetic treatment at the "f" maximum. Stabilization of the hardness above the "f" value was achieved, Fig. 4, by a second stationary magnetic treatment for 2 min. at point "f." Fig. 5—Treatment similar to Fig. 4 but at minimum "h" caused stabilization below the previous minimum

hourly hardness tests were made, and the periodicity of the fluctuations was universally such (see typical curve) that after an immediate rise there was a minimum phase "d" at ½-hr., a maximum "f" at 1½ hours, a minimum "h" at 5 hours, and a maximum "k" at 12 hours after treatment.

If these fluctuations were really due to precession in the atoms, caused by displacement of the axes and a gradually increasing rate of spin after the temporary slowing down, it should be possible to apply an external stimulus to the specimen when it had reached a particular phase of its fluctuations, and thereby change the course of the subsequent fluctuations in a manner which would be easily recognized by comparison with the typical curve. Three results are given in Figs. 3, 4 and 5. In Fig. 3, the wire specimen was given the standard magnetic treatment and aged to the "f" maximum 1½ hour after treatment. The magnetic treatment was again applied for the same period as before, with the result that the fluctuations suddenly became more rapid, the "h" maximum occurring at 2½ hours instead of 5, and the "k" maximum at 4¼ hours instead of 12. The

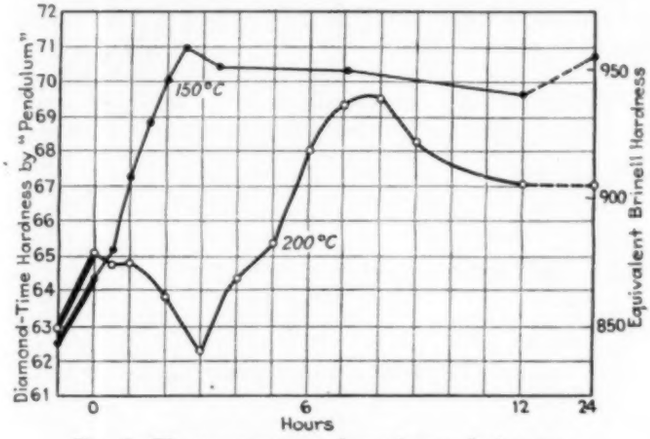


Fig. 6—The temperature of specimens during magnetic treatment and aging has a marked effect on the fluctuations in hardness. The specimens were cobalt high-speed steel

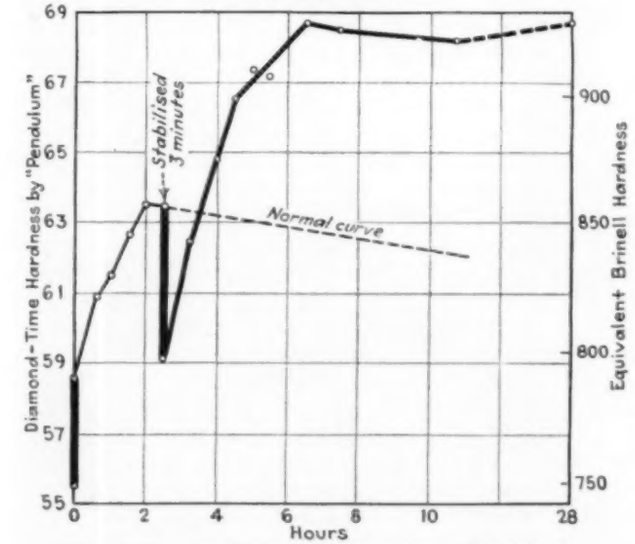


Fig. 7—A gain of one-fifth above the original hardness of cobalt high-speed steel is achieved by the standard rotary magnetic treatment, followed 2½ hrs. later by a stabilizing treatment for 3 min. in a stationary magnetic field

"atomic top" had been gradually increasing in speed, but the renewed magnetic disturbance slowed it down again and set it in rapid precession.

In Fig. 4 a specimen of the wire was given the rotary treatment at "a," aged as before to the "f" maximum, and then placed for 2 min. across the magnet poles without rotation. It was anticipated that if the atomic axes were in precession, this treatment would hold them rigid and parallel to the lines of magnetic force, and would thus cause the precession and the resulting hardness fluctuations to cease. This anticipation was partly realized. The immediate effect of the stationary field was to cause a flutter of rapid oscillations, but in half an hour these had almost ceased and the metal had become virtually stable above the previous maximum. Fig. 5 shows the result of a similar experiment, the stabilizing treatment being applied in this case at the "h" minimum, 5 hours after the original magnetic treatment. This led to stability below the previous minimum. These experiments have placed the precession theory in the position of a useful working hypothesis, and have suggested a secondary or stabilizing magnetic treatment, whereby it might be possible to render permanent any selected phase of the fluctuations set up by the rotary treatment.

Fig. 6 shows the hardness fluctuations resulting from rotary magnetic treatment of two specimens of cobalt high-speed steel. The specimen treated at 150 deg. C. gave the "Rrf" sequence, and the specimen treated at 200 deg. C. the "Rfrf" sequence. Fig. 7 shows a specimen given one turn in the magnetic field at 150 deg. C., and aged until 2½ hours after treatment when it was seen to have reached the maximum hardness. It was then placed cold for 3 min. across the magnet poles and further aged. The "flutter" consisted of a pronounced fall of hardness, followed to a rise to stability high above the previous maximum.

The magnetic stabilizing process has also been applied to fluctuations set up by simple quenching, and to those caused by cold working. A case of the former is illustrated in Fig. 8. Steel wire was quenched from 780 deg. C., and maximum hardness was seen to have been

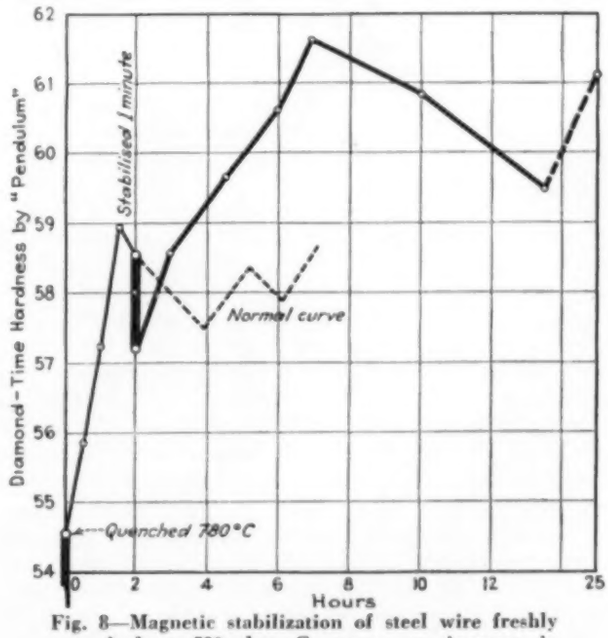


Fig. 8—Magnetic stabilization of steel wire freshly quenched at 780 deg. C. causes an increase in hardness

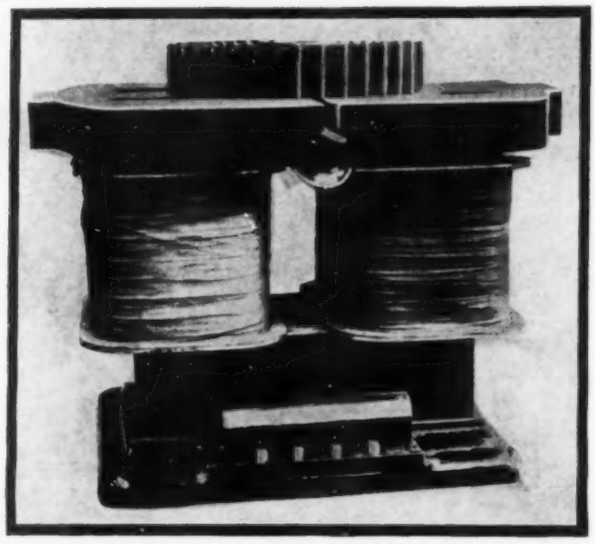


Fig. 9—An electromagnet that can be used on a commercial scale for both the rotary and stabilizing magnetic processes

passed after two hours. The specimen was then stabilized for 1 min. in the constant field. The normal course of fluctuations, shown by the dotted line, was instantly changed, and after a temporary fall a cycle of new fluctuations was set up, having a very slow periodicity and culminating in stability above the previous maximum. This result has been obtained on a variety of metals.

These conclusions open up a new field of research of vast extent, offering a prospect of practical applications whose character and importance can at present be only dimly visualized. What, for instance, of the fluctuations known to occur in freshly hardened tool steel? This steel passes through a temporary phase in which it is so ductile as to be easily bent, though at the same time, it is so hard as to resist attack with the file. There is already evidence that this peculiar condition is susceptible to magnetic treatment.

Fig. 9 shows an electromagnet designed for carrying out the rotary and stabilizing processes on a commercial scale. The two tables are adjustable to provide a gap 12 in. long and of any desired width. This gives a ready means for varying the strength of the magnetic field. Both tables are reversible for the purpose of providing a concentrated field in a short gap of any desired width.

The rotary treatment is given by placing the specimen across the gap and rotating it so that the direction of polarity is varied through 360 deg. A cylindrical specimen such as a drill or wire is placed in the entrance to the gap and rotated about its own axis. The stabilizing process consists in placing the specimen across the gap for a short time, usually a minute or more, but stabilization can only be effective if applied at a definite period after the rotary treatment, being timed to coincide with a selected phase of hardness fluctuations, as determined by serial testing in a previous experiment. The rotary treatment is usually applied to high-speed steel at temperatures of 150 deg. to 250 deg. C.

A Small-Shop Kink—*Discussion*

GEORGE D. TAYLOR

IN AN ARTICLE under the title above (*AM*—Vol. 75, page 898), Charles H. Willey tells how he disposed of an excess of 1 in. on twelve steel plates, the time being 30 min. for each plate. At the end of the article he says, "Perhaps there is an easier way to do this job in a shop equipped only with light tools." Mr. Willey also says that he tried several methods of doing the work, including the use of a slitting tool in the shaper, but found that the tool dug in.

If Mr. Willey had bent his shaper tool so that the cutting edge was back of the toolpost collar and rounded the cutting edge, the tool would have sprung away from the chip instead of digging in. Under these conditions, I am quite sure the shaper method would have been a good way to do the work. However, a faster way would have been to have stood the twelve pieces on edge in the shaper vise and to have planed off the excess metal.

At first thought, shaping off 1 in. of stock seems out of all reason. However, even if the plates were chrome-nickel steel they could have been machined by a high-speed tool at 35 ft. per min., with a feed of $\frac{1}{16}$ in. and a cut $\frac{3}{8}$ in. deep. By setting the shaper stroke at 16 in., which is plenty for a 15-in. cut, the tool would make one round trip in 32 in., or $13\frac{1}{4}$ round trips per min., assuming the same speed for cut and return.

The twelve plates would have a total width of $4\frac{1}{2}$ in. Adding three strokes for the approach, one cut across the work would take 75 round trips of the tool, and the time would be about $5\frac{3}{4}$ min. Allowing $\frac{1}{4}$ min. for returning the tool to the place of beginning for the next cut would make the time about 6 min. for each cut across. As each cut is about $\frac{3}{16}$ in., six cuts would be required, so that the total time would be about 36 min., as against 6 hr. for the milling machine.

If the shaper was old and decrepit and could only take a cut $\frac{3}{32}$ in. deep with a feed of $\frac{1}{32}$ in., the time would still be less than $2\frac{1}{2}$ hr.

I was once foreman of a plant building wood-working machines, where there was a department for making knives for the machines and for our customers. The knives, 9 in. long, were cut off of blocks that were rough forged to a thickness of $\frac{7}{16}$ in. As the blocks came from the hammer they were not all of uniform width, so that as much as $\frac{1}{2}$ in., or more, of excess metal had to be removed. Several knives were clamped together on a carriage running on a truck in front of a 6-ft. grindstone running at 200 r.p.m. This method of removing the excess metal went unchallenged until a breakdown occurred and knives were badly needed.

At the time, the only available machine on which to do the work was a 15-in. shaper having a vise that would hold ten knives. No one expected that the shaper had a chance against the grindstone, but knives we had to have. I ground a round end on a side tool, gave it good clearance on the back and quite a shear on the shaving side, set the tool at an angle of about 25 deg., added a cup for a water drip and said "Gid-dap." The result was far beyond our expectations. There were scads and scads of chips—not broken off or in little curls, but long slender ribbons. The knives were made in lots of 1,000, and when possible, the shaper was used to make chips of the excess metal.

The First Bronze Welding Electrode

JOHN A. TANSLEY

DURING the World War, I was connected with one of the large power companies, which during that period amalgamated with another large company of the same nature. This consolidation brought the operating and maintenance of the latter company under the direction and supervision of the department heads of the former.

The turbines were working under a hydrostatic head of about 185 ft., and the bronze runners were subjected to small stones, gravel, sand, and other materials of an abrasive nature, besides the wearing action of the water. Since this wore the vanes of the runners off rapidly, they soon became inefficient and sometimes useless.

The company had adopted a plan of reclaiming the runners by trimming around the edge of the worn vanes and casting pieces to fit. These pieces were brazed in place.

At this time, electric arc welding was still in its infancy. It was generally assumed by arc-welding engineers that non-magnetic metals could not be successfully worked with the electric arc.

Practical or Impractical?

The operating superintendent had mentioned this to the writer several times, and said that if we could only weld the pieces in the vanes by the electric arc, it would be a great saving. The writer talked the situation over with the welding equipment engineer of the United States Light and Heat Company, and we had just about concluded that it would not be practical on machinery, where it cost so much to take out and replace, and where the service was so severe on the material.

However, as I was not quite ready to give up the idea, I decided to make one attempt before doing so. Having a small brass foundry in the plant, we cast a stick of bronze of the same formula as the wheels which were 88-10-2—that is 88 per cent copper, 10 per cent tin, and 2 per cent zinc, which is a hard mixture. This stick was about $\frac{5}{8}$ in. thick, $1\frac{1}{4}$ in. wide, and 12 in. long in the rough. We broke it in the middle and prepared it for making the weld.

Fully believing that it would not be possible to make the weld with a bronze electrode, I decided to use a soft iron wire. Having everything ready, I handed it to one of the welders and told him to weld the piece. The fellow looked as though he thought somebody's brain had got out of balance, and said he did not think that he could do it.

Try it, Anyway

He was told that he could at least try it and that there was no reason in the world why it could not be done. He started, and of all the sputtering and flying of hot metal! Every time he got the electrode within arcing distance of the bronze, it would just simply fuse and get out of the way, without any respect for persons who happened to stand near enough to get hit. The man said, "I cannot weld that stuff, it all flys away," but we decided to reverse the polarity of the current, and try again. This time it worked. The piece was machined up and the weld was very satisfactory. It was shown to the chief engineer and also the mechanical engineer. The chief suggested that we get out a test piece of standard form and dimensions, and send it to the testing laboratories in Buffalo, N. Y., to have it tested for strength.

The writer phoned Mr. Bauer of the U. S. L. & H. Co. and informed him that we had been successful in welding the bronze, that it looked as though it might be practical to weld the wheels, with a soft iron wire, and that we were casting a test piece which we were going to have tested. Mr. Bauer came to the plant, looked the weld over, and said, "I believe that I can do still better than that." He asked us to get out a test piece for him, which we did, and he made a successful weld with a bronze electrode.

The two pieces were sent to the laboratory and tested. The soft-iron wire weld tested at about 87.5 per cent of the regular engineering standard, and the bronze wire weld about 85 per cent. We adopted the bronze wire weld, as the deterioration caused by moisture was not so great as with the iron.

Iron Penetrates the Bronze

A rather interesting characteristic in the iron-wire weld was that the iron seemed to penetrate the bronze about 2 in. each way from the center of the weld. The general appearance and color of the metal presented an iron surface although the fusing took place for only a space of about $\frac{5}{8}$ in.

We then got a wheel ready for welding. Mr. Bauer and the writer started a man in on welding the vane sections into the wheel. Some years later this man appeared before the Society of Welding Engineers at a meeting held in Buffalo, N. Y., where he was recognized as the man who had perfected the art of welding bronze by electric arc.

In all due fairness, let me state that the man referred to did not know about the experimental work that had preceded his when he was put on the work. He could have naturally assumed that he was the one who should be credited with the achievement. However the idea was suggested by Benjamin F. Lee, electrical engineer, was put into effect by the writer, and improved upon by Mr. Bauer, electrical engineer and expert on electric arc welding and arc welding equipment. The test pieces were welded by Edward Kick.

The FOREMAN'S ROUND TABLE

Overloaded

"SAY, AL, while I'm waiting for my ham and—, tell me something. What were you and Williams studying so deeply this morning? You didn't even notice me going through your department?"

"Williams will tell you himself this afternoon; and don't go off half-cocked when he talks to you either."

"What would I go off half-cocked about? Open up. What's in the wind?"

"Well—and keep this strictly under your hat, Ed—Williams doesn't want to start any argument until he is ready to put the plan in operation, but he is going to run our machines on the multiple-machine plan."

"What? It won't work. Every shop in the country tried that ten years ago and it failed. Men simply will not run more than one machine unless they are automatics. And we have mighty few of those."

"When I said that, Ed, I had in mind milling machines, grinders and a few of those new self-tripping drill presses we bought when we were flush. Of course, a man can't run two lathes on short miscellaneous jobs."

"No, and he can't run any two machines on the mixed work we have here. How in blazes could you ever set time studies on them? It would take a Philadelphia lawyer to figure how much a man earns. How many machines does he figure on one man running?"

"Oh, Williams don't care. The man can run as many or as few as he wants to, maybe three or four or sometimes only two. The number don't count. It will be up to the man. In some cases several men may run a group. I have fourteen milling machines of all kinds and sizes and I figure five men will run them all."

"But you'll need time study for that. How will you divide the labor up? How will you apportion the time on running all those machines? Holy cats! It will take a bookkeeper to every group. The only kick on many of the incentive schemes we are already afflicted with is that the man can't figure out how much is coming to him. In one place I worked, they gave each man a statement every day. But that's expensive."

"Well this scheme won't be complicated because there will be no piece prices, no apportioning for different number of machines, and each man or group can operate just as few or just as many machines as he or it wishes, and at any speed and feed he feels like."

"Say, the first whistle will blow in a minute and I want to hear what crazy scheme Williams has now. From what you say it looks like the men were going to work for nothing. Come across. I won't tell."

"Well, it's simple enough. You and I will have the stops set on our milling machines, grinders and those drill presses that have trips, and we'll pay the men just for loading, same price for everything. The man won't have to hurry to keep the machine going, it will come up against the stop and run idle until the man gets around to load it again. The man won't realize that he's running multiple machines, the only thing he'll want is enough machines to load. The beauty of it is that most of the work can be held in the vise, or on the magnetic chuck, or between centers. Big lots and little lots make no difference. All we really do under any incentive plan is to pay men for loading, plus the time they stand around waiting to load. So now, we'll cut out the waiting time."

"That sounds all right, but where are you going to get the machines?"

"Williams figures on starting up all our old machines. The more we start up the fewer men we'll need. Williams feels that with all the expanding we did, we'll have a surplus of machines for the next two years at least."

Is it logical to pay for loading only? Will the net result of this go-as-you-please method be profitable? Are there any "bugs" in the proposition from the standpoint of either men or management?

Discussions

Poetry of Motion

Under conditions where machines with fixed cycles are used, the further study of these is of value only for check for possible improvement, and this, with modern machines, is rather an optimistic task and likely to result in the conclusion that the machine is right. In intermittent work of any nature, there is a certain amount of time spent on manual operations, and as these operations are usually performed on standard machines, the field for discovery of lost motion is naturally more fertile. The operations of handling usually offer the richest source for improvement, while the use of an unsuitable machine which sometimes happens, should be checked in this manner also.

The great danger in all these studies is the employment of persons without balance or proper judicial faculties or a bias toward their particular study, either from selfish motives or ignorance. Broadly, the divisions of time and motion are the basis of planning, and it is often an argument to decide whether the tail or the dog shall control the wag. Timing and recording with stop watch and chart, or photographing and observing without the proper sense of values, are useless.

—JOHN S. ISDALE.

Run-of-Mine

There is no reason to think shop workers are below other departments in intelligence. It is only a delusion one is liable to when some mistake occurs. Even laborers are usually sharp and intelligent, far above their job. The unfortunate thing is, men are often held back by their own colleagues, or dismissed for one thing or another by the time they are useful. In proportion, workmen are as smart as office men. The difference is, one has been trained in a little higher grade school, had better parentage, and perhaps was designed from the outset to occupy a higher position than workman. The truth is, some of these are very ordinary mortals, and no example morally or intellectually for working men.

There is evidence of increased intelligence as years go by. Modern educational facilities have greatly improved the stock, consequently, modern working youths are of a higher type than formerly. Take the average man from the works gate, and with fair instruction on the job, he will invariably make good. A semi-skilled man could be trained as toolroom hand in less than a year, and many skilled mechanics are fitted for higher positions,. There is manifest in the workshop a willingness, keenness, and intelligence, which rather surprises those who were educated forty or fifty years ago. Not one out of three, but two out of three, make good, providing someone is available as instructor. A good instructor will justify his existence and salary, and the wonder is they are not more generally employed.

—WM. BRYCE, *Sheffield, England.*

Old Man Opportunity

I firmly believe that it is to the company's advantage to give an ambitious chap the opportunity to learn something else beside his routine work, but the foreman should feel sure that the particular kind of work the employee wants to acquaint himself with in his spare time, will be to the employee's advantage in advancing himself. For instance, there would be no advantage for the ambitious chap to learn tool making when his aptitude is distinctly for production work. In that case, it would be more to his advantage to acquaint himself with as many different kinds of machines and operations as possible. He would then be in a position to make suggestions to improve methods, thereby advancing himself and at the same time making money for the company by increasing production.

—M. S. KLEIN.

Treasure Chests

The purpose of any suggestion system is to encourage the workman to express his ideas for speeding production, lowering costs, or improving the quality of the product. It is an accepted fact that the man on the job is worth a hearing once at least even though his experience may be limited.

Sometimes a workman with a ready eye for points of improvement will hesitate to suggest a change because he fears that the foreman may think he is being shown how to run his job. This may occasionally be true, but every man responsible for collective results should be quick to recognize the man who has initiative enough to see where a method can be improved.

The first step in submitting a suggestion for fair consideration is to put it in writing. Many good ideas have been lost through being told to some good fellow who promised to "look into it," but when in the rush of other work forgot all about it. An idea recorded on paper can be discussed at convenience by a committee of interested parties.

—GEORGE LAIDLER.

Traffic Congestion

The problem of jobs held up in the shop is an old one and can usually be traced to lack of equipment or shortage in personnel. In our own plant for years, the practice was to set up a job when material and machine were available and then run it off if possible. However, in a great number of cases, the sales department, the stock clerk or the foreman from another department wanted something in a hurry and some job had to be torn down and the new one set up, with the consequent loss of time.

A properly organized planning department can eliminate most of these transfers and changes, but some of us cannot afford a planning department, and the following scheme was adopted by our company.

When a production order is issued to the shop, a small perforated ticket is made out for each operation involved and issued with the order. These tickets show the number of the machine, the operation to be done, the number of pieces to be run and the date when the parts or assembly will be needed. A control board in the shop is equipped with two sets of hooks for each machine in the shop. The tickets are hung on the lower hooks. The job actually on the machine or first out is hung on the top hook. Thus any shortage of operators or lack of equipment is instantly apparent. Breakdowns or other unforseen delays are noted on the ticket, which is forwarded to the office upon completion. A job takes precedence over another of earlier date only upon authority of the superintendent.

—L. B. JONES.

A Puzzling Taper Groove

CHARLES KUGLER

A disk 20 in. in diameter and 1½ in. thick is slabbed off on one edge so there is a flat of about 14 in. An accurate tapered groove is to be cut in the periphery. The groove has a semicircular cross-section throughout its length and is ½ in. in diameter at one end and 1 in. at the other. This problem was presented to our readers (*AM*—Vol. 75, page 466) and inspired many interesting solutions

MANY old die and tool makers will recall how they used to bore taper holes on milling machine, boring mill, or drill press. The principle is shown in Fig. 1. The guide bar *G* is set to an angle, corresponding to the desired taper, and made fast to the milling machine.

An adjustable boring head of the common type, without transverse screw adjustments, is inserted in the spindle to carry the boring tool. The head slide *S* is provided with a contact piece *R* to strike against the guide bar at each revolution of the spindle. The work is advanced with the finest possible feed, and the slide of course follows the guide bar much the same as a cross-slide follows a taper attachment. It is my belief that the taper groove can be finished by making use of this same principle with the addition of a revolving milling machine table whose function is to revolve the cam and disk. The cam can be made on the lathe by gearing it to cut a pitch of 0.3267 in. which is calculated as follows:

There is ¼-in. difference in the radius of the groove in 47.3019 in. Therefore the taper per inch equals 0.250÷47.3019=0.0052 in. Since the circumference of entire disk is 62.8319, the taper in this distance equals 0.0052×62.8319=0.3267.

If necessary, this cam can be hardened and then ground in the lathe. With the disk and cam revolving on the table and the contact piece *R* striking the cam with every revolution of the spindle, the radius of the fly cutter is always increasing and should make a continuous taper groove corresponding to the rise of the cam.

It may be that a small end mill could be used instead of the single-pointed fly cutter for rigidity. Further, it may be necessary to have a definite ratio between the speed of the circular table and the speed of the fly cutter. This could be determined by experiment. The disk and cam would be fastened to the table in the most convenient manner. Since a revolving table is part of the equipment of some milling machines, the only part to be made would be the cam. Should there be difficulty in finding suitable gears to cut this cam on the lathe because the pitch is an odd one, by using continuous fractions, a pitch, differing a negligible amount from the correct pitch, may be found that can be cut with available gears.

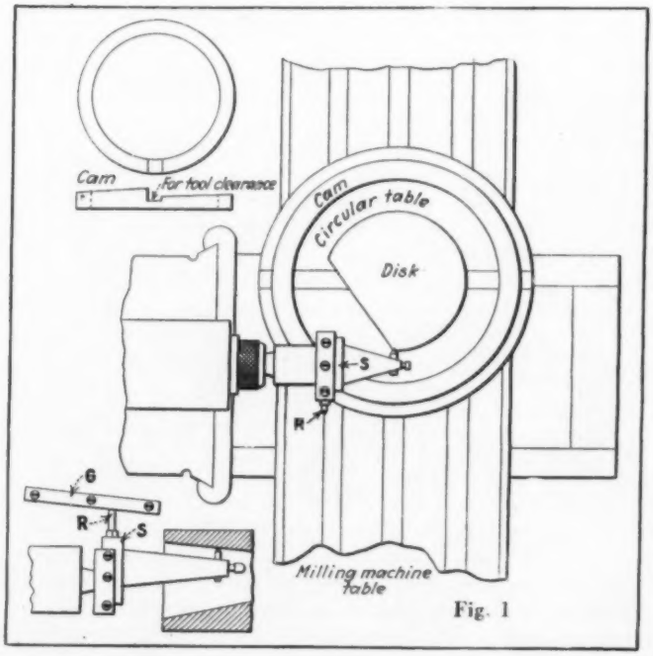
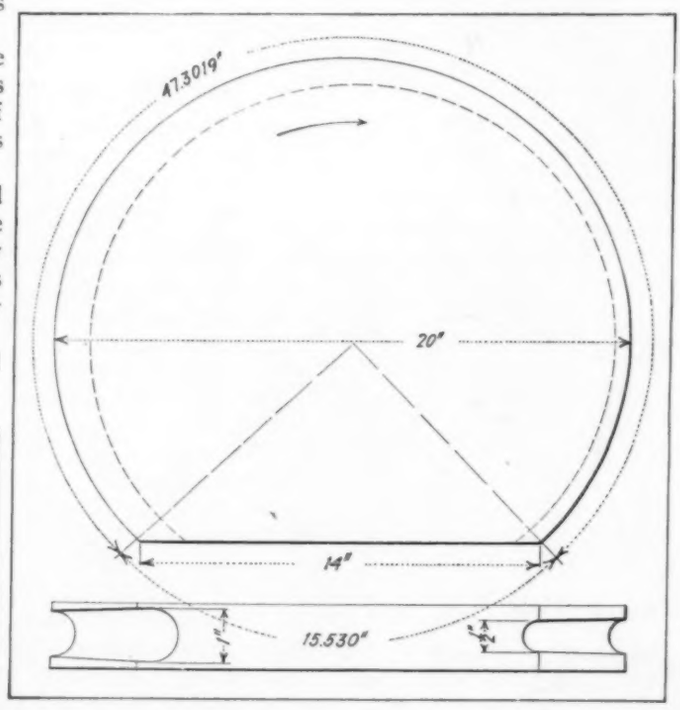


Fig. 1



V. V. VEENSCHOTEN
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It is obvious that to make a perfect groove, tapered from one end to the other (*AM*—Vol. 75, page 466), the cutter should be as long as the groove, which is approximately 47¼ in. long. A cutter ½ in. in diameter at one end, 1 in. at the other end and 47 in. long is, of course, out of the question. But it would be possible to make a series of cutters which could be used successively, the smallest one having a small diameter of ½ in. and teeth cut for a distance of 3 in. The next cutter could be 3½ in. long, the next 4½ in., 6 in., 8 in., 10 in. and 12½ in., which would complete the groove. The cutters would be advanced at the same rate as the disk. The radius of the spiral, formed by the bottom of the groove, is always equal to 9¾ in. minus $\left(\frac{A}{271}\right) \times \frac{1}{4}$ in., where A is the angle in degrees through which the disk has moved from the start.

Without going through all the calculations to determine the error caused by the difference between the taper of the groove and the taper of the milling cutter 9 in. long, as suggested in the article, it is evident that the error is zero at the point of contact of the milling cutter and the bottom of the groove, and is also zero where the bottom of the cutter is flush with the edge of the disk. Somewhere between these points will be found the greatest error, and taking a point half-way between as approximating the greatest error, the cutter will make a groove 0.0117 in. wider than necessary. Probably a cutter half-way between 9 in. and 47¼ in. would reduce this by half.

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Referring to Fig. 3, the upper view is a cross section and the lower a view looking down upon the job. The 20-in. disk *A* is mounted on the indexing head *B*, turned in a vertical position.

A Casler offset boring head *E* is used for machining the groove. This has a capacity of ⅜ in. stock, but the tool can only be ¼ in. from the center line to the finished hole at the end used for the boring. By trigonometry the 14-in. flat represents 88 deg. 52 min. The circumference equals 62.832 in. The part to be machined would equal 47.322 in.

Assume that the disk *A* is to move forward 0.001 in. approximately per revolution of the boring tool *H*. By using a standard roller chain and sprockets to drive the index head from the milling machine spindle, a 20-tooth sprocket *D* on the spindle drives an 80-tooth on a 40-1 speed reducer. The speed reducer with an 8-tooth sprocket drives an 85-tooth sprocket *C* on the index head. The speed reducer is not shown but is clamped on the milling machine table.

To obtain a smooth continuous groove, the boring tool *H* must be fed in ¼ in. during 271 deg. 8 min. of the circle. This may be accomplished by fastening a small gear on the micrometer adjustment of the Casler boring head *E* and meshing with it a rack *F* fastened in guides on the boring head with a brake on the rack. One revolution of the micrometer adjusting screw equals 0.100 in. If a gear ⅜ in. diameter were used the movement of the rack would be 2.925 in. Therefore, the wedge *G* would have a taper of 2.925 in.

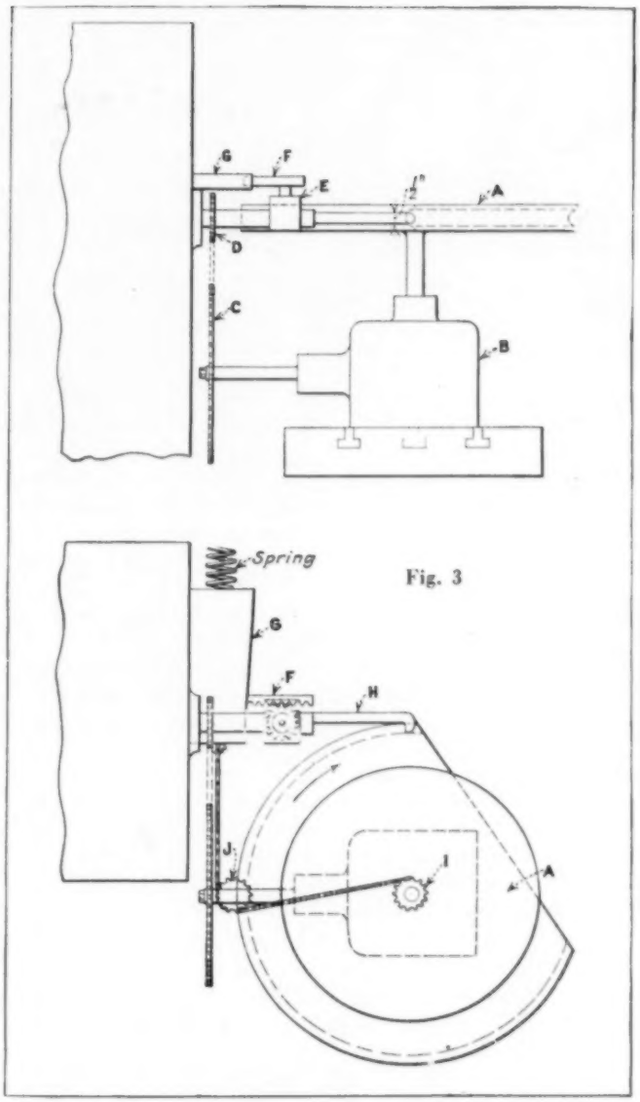

Fig. 3

The length of the tapered portion of the wedge depends on the sprocket or roller *I* as strip steel can be used as well as chain. The sprocket *I* is fastened to the disk *A*. If a 2-in. diameter sprocket is used, the circumference of which would equal 6.2832 in. and the 20 in. disk *A* turns $\frac{271.133°}{360}$ of a circle, the length of the tapered portion would be 4.732 in. Each time the spindle revolves, the end of the rack *F* strikes the tapered wedge *G* and feeds the tool in automatically. The groove is first roughed out in the lathe. An idler *J* makes a straight pull on the wedge by the sprocket *I*.

Five cuts will be necessary to machine the groove. In setting for each cut, the sprocket *I* may be adjustable to start the cut at any portion of the disk. To save time in reversing the disk, instead of running the machine backward, the chain can be slipped off and the regular index handle used to return to any starting point.

A. SEIDE

The attachment shown in Fig. 4, which is for a lathe, will take care of this job. The cross slide and cross-slide screw of the lathe support are removed and replaced by slide *A* and shaft *B*. Shaft *B* is fed by the gear in front

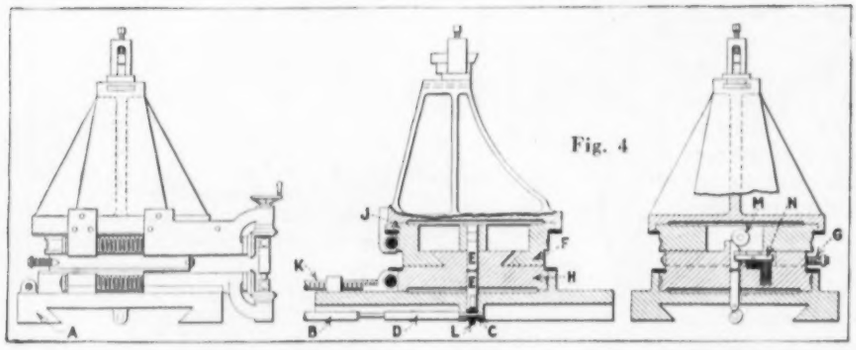

Fig. 4

of the apron. Shaft *C* connected with hollow shank *D*, carries the cam *L* which moves the rods *E* in a vertical direction. The upper shaft *E* contacts with roller *M* to produce a stroke equivalent to the increase in the radius of the groove. To avoid jamming roller *M* with upper rod *E*, lever *N*, by means of the spring shown, holds rods *E* in contact with the cam when travelling in off position.

The gearing of the lathe is set so that every revolution of the disk pushes the slide *E* the amount of increase of the radius in a horizontal direction. Spring *G* forces it back into the original position while the tool is going over the flat side. To secure this stroke at angular positions for an arc of 180 deg., turntable *H* is moved by means of a worm. In order to keep the direction of the tool at right angles with the axis of the workpiece, arrangement *J* compensates the rotating movement of *H*. The two worm shafts are connected by universal joints. Thus the tool is actuated to give the work angular relief during each revolution without altering its angular position.

The cutting tool is ground to the minor radius of the groove and set concentric with the pivot of the attachment when the upper slide is in its off position. This may simply be accomplished by means of a set-up gage which will be held against a machined face on the toolholder pedestal. It may be mentioned that a convex radius cutter mounted in the toolpost will eliminate the work of making a special tool. Interchangeable cams at *L* make it possible to work various diameters and ratios as well as shapes of grooves. Adjusting screw *K* will allow the turning of all diameters of disks within the range of the lathe.

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The solution originally given which suggests the use of a helical tapered milling cutter, seems to be suitable for roughing-out purposes, but because of the interference existing, some other means must be adopted for the finishing cut.

It is evident that the difficulty can only be removed by the application of a cutter which cannot find contact with the work over an area and so cause interference. It is safe to assume that the stock to be removed by the final cut will be small so that some decrease in the rigidity of the cutter may be tolerated.

The tool bar designed to take the finishing cut and to correct the interference that has occured in the roughing-out process, is shown in Fig. 5. The work is rotated about its axis for the final cut as for roughing purposes, but no other movement of the work relative to the tool bar is needed.

At one end, the box *A* is turned to fit the taper bore of the milling machine spindle, the rest of the box being parallel, and screw-cut 12 threads per inch right-hand for part of its length. The chamfer at the other end provides a clearance for the passing of the work. The bore is not on the center line of the box but is tapered to it, the amount of taper being $\frac{3}{4}$ in. per foot in this case. A slot is cut through the box on a diameter in line with the eccentricity given to the bore. *B* is a bushing which adapts the tool bar *C* to the box *A* and is a stiff sliding fit to *C* and *A*.

At the end of the bore of the box *A*, an elongated recess is made to form a clearance for the end of the tool bar *C*. The turning effort is transmitted direct from the machine spindle to the cutting tool by the pin *D*. This pin also prevents end movement of the tool in the box. The nut *E*, transmitting longitudinal movement of the bushing *B* through pins which are screwed tightly into the bushing, governs the cutting radius of the tool.

The toothed wheel *F* is keyed to the box *A* and drives the wheel *G* through a train of wheels, the other spindle being carried by a knee on the machine table. The wheel *G* actuates the nut *E* by means of a barrel, cast integral with the wheel. The bore of the barrel is a sliding fit over the nut, a keyway being cut down the barrel, and a sunk key fitted to the nut. The collar *H*, which is provided with a locknut, acts as a support to the barrel and takes the thrust.

To find the necessary wheel train:

Pitch of tool feed screw$=\frac{1}{12}$

Travel of tool required to give increase of $\frac{1}{2}$ in. to cutting diameter of tool$=4$ in.

Then the tool feed nut must do 48 revolutions to do the job.

Travel of the work$=48$ in. Assumed feed$=0.02$ in.

Then the spindle does (50×48) revolutions to do the job.

The speed of the nut relative to spindle$=\frac{1}{50}$

Then the speed of nut$=1.02\times$spindle speed$=$ratio of wheel train

$$\frac{\text{Drivers}}{\text{Driven}}=\frac{1.02}{1}=\frac{102}{100}\times\frac{101}{101}.$$

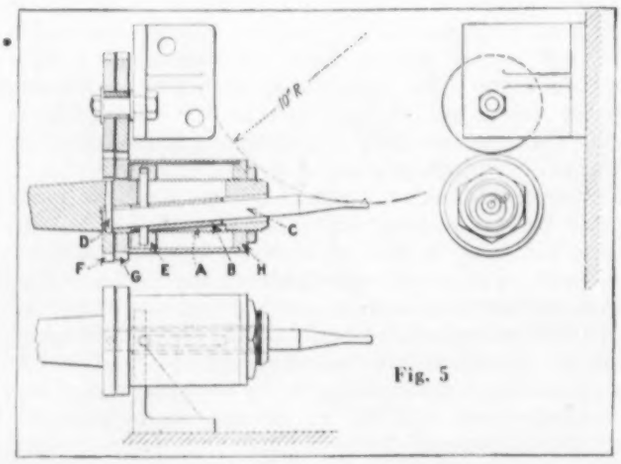

Fig. 5

NEW BOOKS

THE PARADOX OF PLENTY—*By Harper Leech. With an introduction by Virgil Jordan. 203 pages, 5½x8¼ inches. Bound in cloth boards. Published by Whittlesey House, a division of McGraw-Hill Book Co., Inc., 330 West 42d St., New York. Price $2.50.*

What is value? For centuries we have accepted the old estimate of value based on scarcity, and planned our economy accordingly. Now we are in the midst of plenty, and we are astonished to find that the old rules no longer hold.

Starting with this thesis Mr. Leech goes on to show how our present advance is built upon the application of energy in the form of power derived from fossil fuel. His conclusion is that the era of concentration in large cities which was forced by the development of steam power is over, and that the mobility of electrical power is forcing an accelerating decentralization.

Dr. Jordan, economist of *The Business Week*, says: "It can quite fairly be called a piece of pioneer work, and as an economist I am profoundly impressed by its scientific significance. I can honestly say that this book is the only thing published during the past few years that has made me sit up and take a fresh interest in my own field."

Don't get the idea that this book is a dry economic treatise. It is a dramatic and vivid presentation that will hold the interest of any engineer or manufacturer, and it is guaranteed to make him sit up and take an interest in the present.

WINGS OF TOMORROW (The Story of the Autogiro)—*By Juan de la Cierva and Don Rose. 284 pages, 5x8¼ in. Clothboard covers. Indexed. Illustrated and diagrammed. Published by Brewer, Warren & Putnam, Inc. Available from the Giro Book Co., 1829 Land Title Bldg., Philadelphia, Pa. Price $2.50.*

Flying has challenged man's imagination and engineer's ingenuity since the beginnings of time. At long last came the balloon, then the airplane, but still something was lacking. The balloon was an expensive, bulky arrangement, the airplane a tricky "crate" that demanded constant attention of a skilled pilot. Came stories of a "flying windmill that could fly straight up or down and hover like a hawk." We know it now as the Autogiro, manufactured by several American companies. This book is the story of its invention, also the life story of its inventor. It grew from such strange beginnings as the crash of an expensive bomber, the discovery that flexibility—almost fragility—was stronger than rigidity, and a trip to the Milan Opera.

Frankly publicizing the 'Giro, this book is nevertheless worth reading from cover to cover. Only half of it is the biography; the remainder describes the principles of the machine and its possibilities. A technical supplement is included for the engineer. But the tale is told chiefly for those, engineers or not, who foresee the future of aviation, in accurate, authoritative, yet comprehensible terms. It explained for this reviewer some things about the machine that no amount of technical and non-technical reading has been able to do, and it warmed the cockles of his heart to know that the vital element in the operation of the "windmill" is its rotor hub, an exclusively machine shop product if there ever was one.

MACHINE DRAFTING—*By George C. Snow and J. Charles Russell, Instructors, Waltham, (Mass.) Evening Vocational School. 159 pages, 6x9 in. Indexed. Appendixed. 187 illustrations. Clothboard covers. Published by the Manual Arts Press, Peoria, Ill. Price $1.48.*

Planned particularly for use in evening vocational schools and machine shop apprentice courses, this text was written by the former chief draftsman of Waltham Watch Company and another skilled machine designer. Unlike other texts on this subject, it includes chapters on principles of designing, calculating, materials of machine construction and machining—at the same time teaching approved methods of presentation on paper. It is actually a graded course of problems in machine design, each requiring the student not only to execute the drawings, but to design the part or machine correctly. Thus the purely mechanical function of drawing is coupled with the use of mathematics and science as they are used by the expert designer.

The authors' method of presenting the problems, 38 in all, is to give a typical problem worked out in full detail. Then the student takes the data given for similar problems, and with the aid of the text section of the book and such other books and catalogs as may be available, he works out a similar problem.

The manual is simple, easily understandable, and on the whole creditably written. Illustrations are clear and aptly chosen, and content is superior to that in most books on this subject.

SYMPOSIUM ON EFFECT OF TEMPERATURE ON THE PROPERTIES OF METALS. —*829 pages, 6x9 in. Clothboard covers. Indexed. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price $6.00.*

Twenty-seven papers by 38 authors have been assembled in this book. They include data on corrosion-resistant metals used in the fields of power plant engineering, chemical industry, furnaces, smelting and oil industries. The authors have summarized the information contained in the extensive literature on the subjects, appraised it critically, and added unpublished information. One section of the book deals with engineering trends and requirements for metals at high and low temperatures, and a second section gives the properties of available metals for temperature requirements. The written comments of other engineers and metallurgists are also included in the book. A specially prepared introduction summarizes the most important points contained in the papers.

Interference in Internal Involute Gears

Exploring a field in which few specific conclusions had hitherto been reached, the authors presented last week some original formulas defining the limits of internal gear tooth interference. These data are made applicable to routine problems of design by the graphs which follow

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HARRY SHAW
Tool and Gear Consultants, Heywood, England

LAST week we showed that internal involute gearing was subject to two distinct types of interference which we designated as involute and trochoidal. Formulas were developed to indicate just when each form of interference existed. From these formulas, the graphs on pages 397 and 398 of this number were drawn.

Graph I, while accorded first place, was actually constructed by combining Graphs II and III (see pages 397 and 398) so as to provide a ready means for disclosing most of the gear combinations that, without departure from standard, are free from interference of any kind. When the intersections of the ordinates fall close to the curve, the exact point is in some doubt. Hence the term, "most of the combinations," is used. For these close combinations, Graphs II and III drawn to much larger scale should be consulted. The replacing in Graph III of the tooth numbers by tooth differences also increases the possibility of accuracy.

Combinations falling in the unhatched portion of Graph I are free alike from involute and trochoidal interference. Combinations in the single-hatched portion minus the wedge-shaped strip suffer from involute interference only. Combinations in the wedged-shaped strip have trochoidal interference. Combinations in the cross-hatched portion have both involute and trochoidal interference.

Graph II separates the gears with involute interference from those without it. Intersections of ordinates below and to the left of the curve denote that the wheel's internal diameter must be enlarged. The curve has been constructed on the following lines.

The straight-sided rack, Fig. 4, has been regarded as the limiting internal wheel. The minimum pinion with which it will not interfere, necessitating undercut pinion teeth, is calculated from a simplification of Formula 28 below, the derivation of which study of Fig. 4 will reveal.

$$t = 2r = 2 \operatorname{cosec}^2 \psi \qquad (28)$$

Since the minimum tooth difference does not depend upon the pitch, it is clear that all calculations can be based on unity module or unity diametral pitch, which in standard gears have an addendum of unity. (Unity module and unity diametral pitch are the same, since the module and diametral pitch are always mutual reciprocals.) A little thought will also show that for our present purpose any gears of similar tooth proportions, even if of metric module or of circular pitch, can be considered to be of unity module. For the $14\frac{1}{2}$-deg. standard, therefore, Formula 28 can be rewritten and evaluated thus:

$$t = 2 \operatorname{cosec}^2 14\tfrac{1}{2}^0 = 31.90294 \qquad (29)$$

From which it is clear that, in a purely involute system with a pressure angle of $14\frac{1}{2}$ deg., the minimum pinion free from involute interference has 32 teeth.

While obviously two equal internal gears cannot form

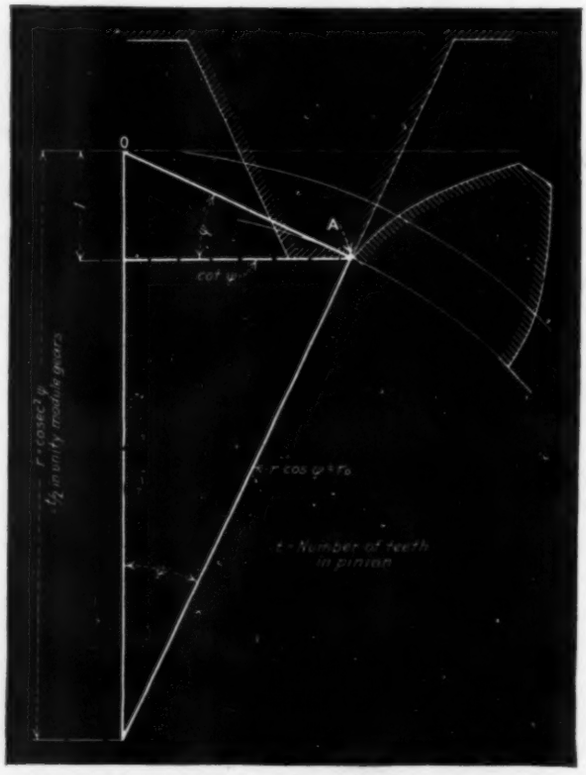

Fig. 4—A rack may be considered to be an internal gear with an infinite radius. Assuming this to be a limiting condition the smallest pinion that will mesh with the rack and be free from involute interference may be computed

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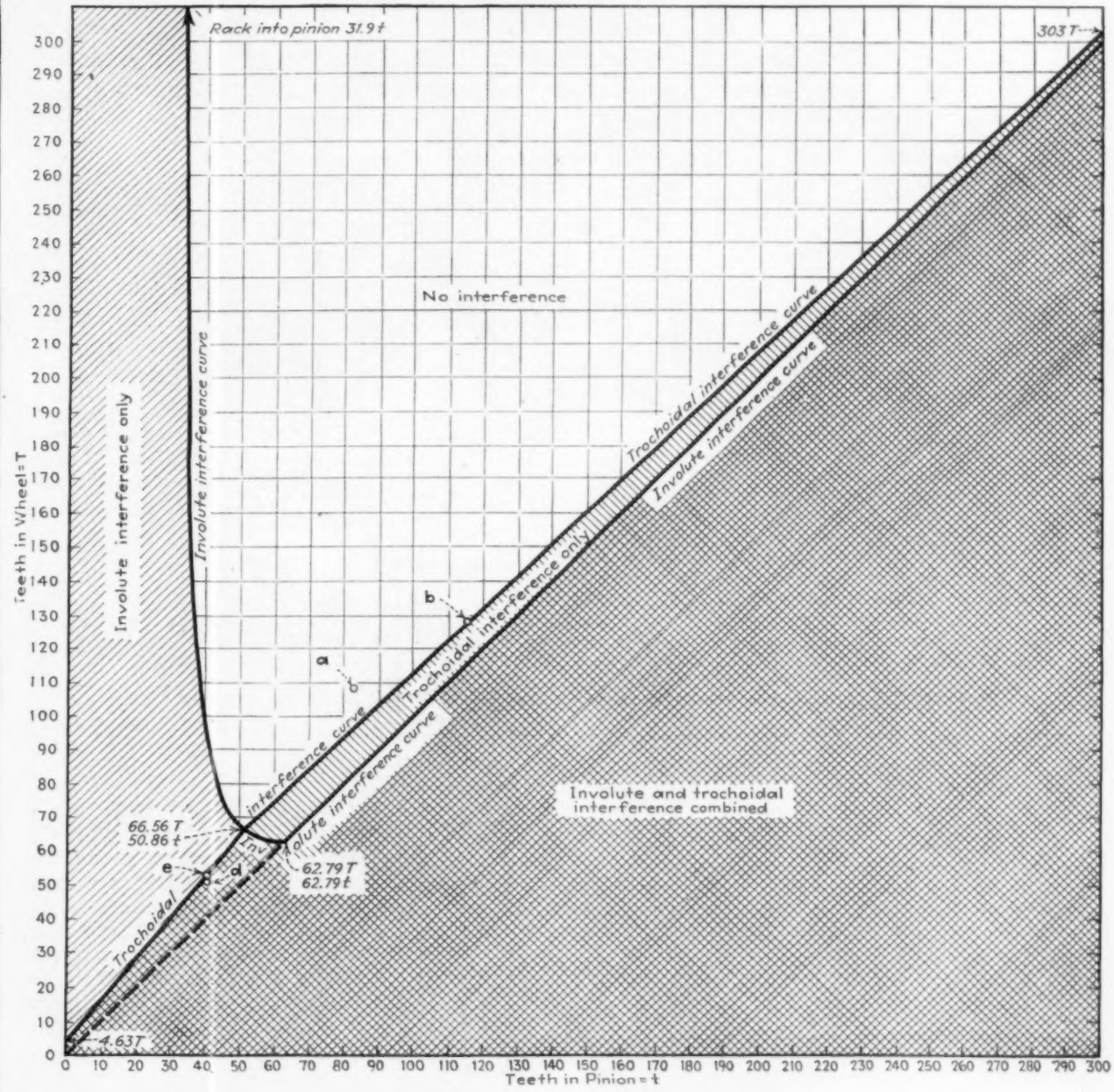
INTERFERENCE LIMITS FOR 14½ DEG. INTERNAL GEARS



GRAPH I—Standard combinations of 14½-deg. involute internal gears the coordinates of which intersect within the "no interference" area may be used without difficulty. Gears having intersections within the "involute interference only" area must have the internal diameter of the wheel enlarged to make them usable. Intersections within the cross-hatched area denote that even when the wheel is enlarged trochoidal interference will exist and that a greater tooth difference or a special tooth form must be employed.

Graphs to accompany the article: "Interference in Internal Involute Gears," by Francis W. Shaw and Harry Shaw.

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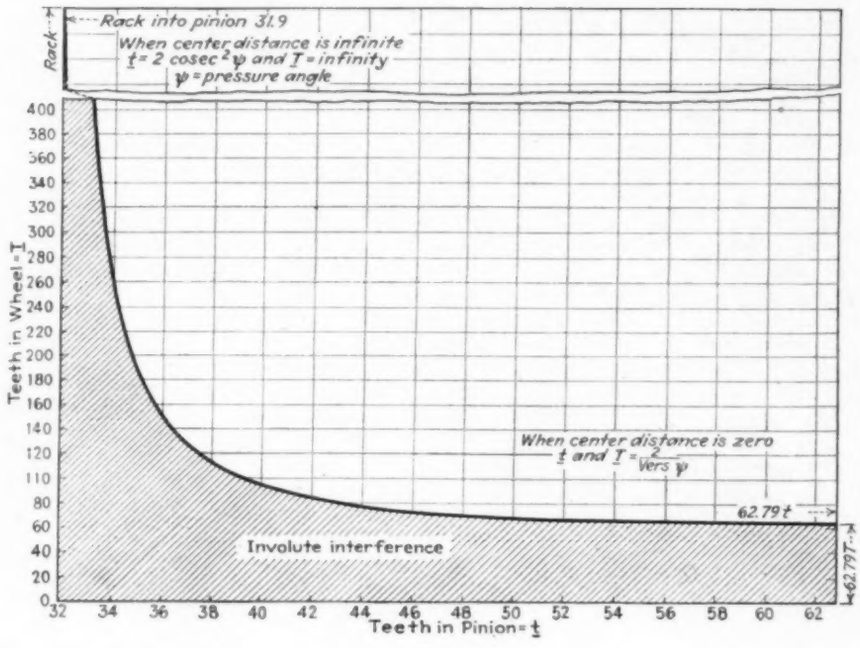
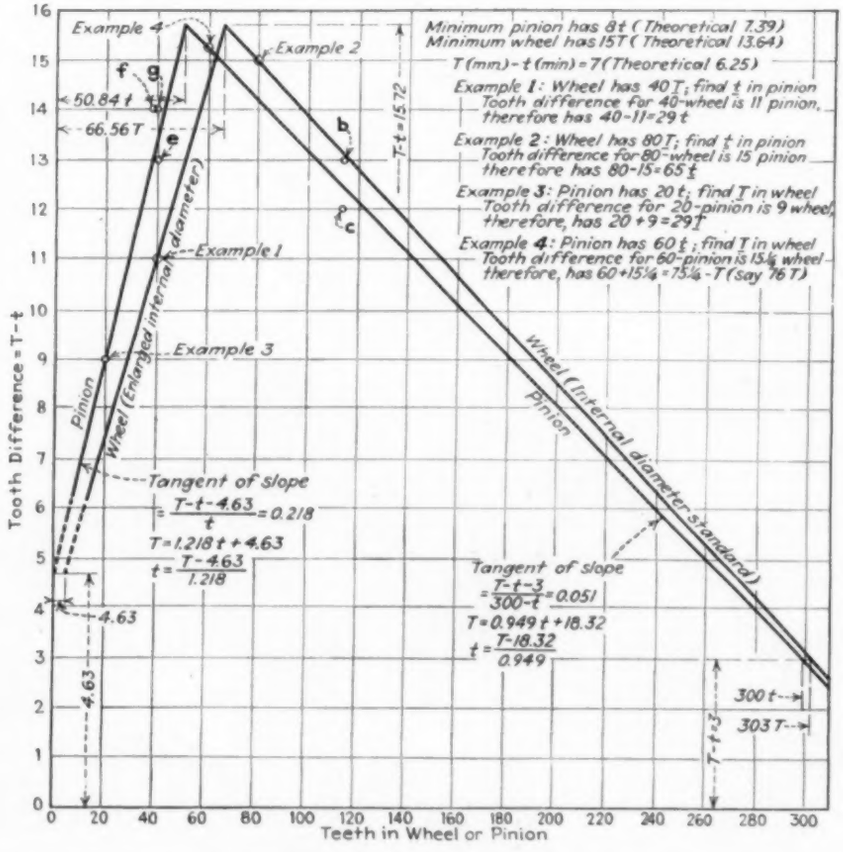
INTERFERENCE LIMITS FOR 14½ DEG. INTERNAL GEARS

GRAPH II—Gear combinations having coordinates which intersect in the unhatched area are free from involute interference. They may be used without modification unless Graph III indicates their tooth difference is so small that trochoidal interference will exist. If the coordinates intersect within the hatched area, the internal diameter of the wheel must be enlarged to the involute interference circle


Rack into pinion 31.9
When center distance is infinite
t = 2 cosec² ψ and T = infinity
ψ = pressure angle
Rack
Teeth in Wheel = T
When center distance is zero
t and T = 2 / Vers ψ
62.79 t
Involute interference
62.79 T
Teeth in Pinion = t


Example 4
Example 2
Example 1
Example 3
Minimum pinion has 8t (Theoretical 7.39)
Minimum wheel has 15T (Theoretical 13.64)
T (min) - t (min) = 7 (Theoretical 6.25)
Example 1: Wheel has 40 T; find t in pinion
Tooth difference for 40-wheel is 11 pinion, therefore has 40-11=29 t
Example 2: Wheel has 80 T; find t in pinion
Tooth difference for 80-wheel is 15 pinion therefore has 80-15=65 t
Example 3: Pinion has 20 t; find T in wheel
Tooth difference for 20-pinion is 9 wheel, therefore, has 20+9=29 T
Example 4: Pinion has 60 t; find T in wheel
Tooth difference for 60-pinion is 15¼ wheel therefore, has 60+15¼=75¼ - T (say 76 T)
T-t=15.72
50.84 t
66.56 T
Pinion
Wheel (Enlarged internal diameter)
Wheel (Internal diameter standard)
Pinion
Tangent of slope
= (T-t-4.63)/t = 0.218
T = 1.218 t + 4.63
t = (T-4.63)/1.218
4.63
Tangent of slope
= (T-t-3)/(300-t) = 0.051
T = 0.949 t + 18.32
t = (T-18.32)/0.949
T-t=3
300 t
303 T
Tooth Difference = T-t
Teeth in Wheel or Pinion

GRAPH III—Having determined the number of teeth in either the gear or the pinion, the minimum tooth difference to avoid trochoidal interference may be found from this graph. The curves are based on enlargement of the internal diameter of the wheel to the involute interference circle where necessary

Graphs to accompany the article: "Interference in Internal Involute Gears" by Francis W. Shaw and Harry Shaw.

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an active pair, for the purpose of determining a point on the graph we may legitimately conceive of such a pair as being the limiting case. Formula 3 (*AM*—Vol. 76, page 364) tells us that just to avoid involute interference B^2 must equal $C^2 \sin^2 \psi + R_0^2$, and if the center distance C is given its limiting value of 0, the formula becomes:

$$B^2 = R_0^2 \tag{30}$$

But, at the moment when involute interference ceases, B is equal also to $R - 1$, and therefore:

$$B^2 = R_0^2 = (R-1)^2 = R^2 \cos^2 \psi$$

that is, $$R - 1 = R \cos \psi$$

From which it appears that:

$$2R = \frac{2}{1 - \cos \psi} = \frac{2}{\text{vers } \psi} = t \text{ (and } T) \tag{31}$$

Therefore, in 14½-deg. standard gears of unity ratio:

$$t \text{ (and } T) = \frac{2}{\text{vers } 14\tfrac{1}{2}^\circ} = 62.7896 \tag{32}$$

The values in Formulas 29 and 32 define the limit points of the curve. Formula 29, however, is useless in plotting, for the point given by it is at infinity vertically, the mating gear being the "infinite" rack. Reference to the graph will illustrate precisely what is meant.

Points on the curve were evaluated by the same general Formula 3 rewrittten in this way:

$$(R-1)^2 = (R-r)^2 \sin^2 \psi + R_0^2$$

which is identical with:

$$r = \sqrt{R^2 - \frac{2R-1}{\sin^2 \psi}} \tag{33}$$

If 14½ deg. be substituted for ψ, this formula becomes

$$r = \sqrt{R^2 - \frac{2R-1}{0.0627}} \tag{34}$$

For approximate calculations the practical equivalent of Formula 34 is:

$$r = \sqrt{R^2 - 16(2R-1)} \tag{35}$$

which is correct for a pressure angle whose sine is 0.25.

Readers are warned that Graph II does not furnish a complete answer to the question, "Does interference exist?" It merely detects involute interference. For possible trochoidal interference Graph III must be consulted.

Graph III indicates the minimum tooth difference any pair of internal gears can have in which the wheel's internal diameter has been enlarged (where necessary) to avoid involute interference. Whether enlargement is required Graph I will already have told by the crossing of the involute and trochoidal interference curves. Graph III has been plotted from points calculated by the formulas already given.

Some may wonder why the curves are not continuous —why a peak exists at a particular tooth difference a little less than 16. The explanation is that at this difference, the difference necessary to avoid trochoidal interference, involute interference has just ceased and an angle, the angle η, not hitherto present, alters the law of the curve. (See Fig. 3 in the first part of this article which appeared last week, Vol. 76, page 365.)

That both branches of the curve appear straight may seem puzzling too. Actually, neither branch is quite straight, though calculations show that the up-sloping branch is almost precisely so and the down-sloping branch so straight that at no point does the tooth difference indicated by a straight line err by more than 2 per cent and this on the side of safety. Analysis shows that the curvature is pronounced where the pressure angle is 20 deg., so it may be assumed that the straightness is peculiar to the 14½-deg. system.

By reason of this straightness, the curves can almost exactly be represented by equations of the first degree. The tangent of the up-sloping branch calculation shows to be almost precisely equal to:

$$\frac{T - t - 4.63}{t} = 0.218 \tag{36}$$

and the tangent (negative) of the down-sloping curve to

$$\frac{T - t - 3}{300 - T} = 0.051 \tag{37}$$

two equations from which the approximate Formulas 40 to 43, following, have been derived.

The position of the peak has been deduced, on the assumption that the straight-line law holds at that point, in the following manner:

From Fig. 2 (in last week's installment), it is evident that in the right-angled triangle QWA, when B is equal to R_t, that is, to $R - 1$:

$$(R-1)^2 = R^2 \cos^2 \psi + (R-r)^2 \sin^2 \psi$$

which, simplified, is identical with:

$$2R = \frac{r^2 - \text{cosec}^2 \psi}{r - \text{cosec}^2 \psi} \tag{38}$$

But the point at the peak of the curve represents a case where $B = R_t$, and must therefore not only obey the law expressed by Equation 38, but also the law expressed by $2R = 2.437 + 4.63$, deduced from Formula 36. Consequently r, the radius of the "peak" pinion, is determinable by the formula:

$$\frac{r^2 - \text{cosec}^2 \psi}{r - \text{cosec}^2 \psi} = 2.437 + 4.63 \tag{39}$$

a quadratic equation which when solved yields a peak value for r of 25.418 and for t, equal to $2r$, of 50.836. The corresponding curve for the wheel has been derived from the pinion curve by a method which a little thought will reveal.

Where the minimum tooth difference must be ascertained with precision and when doubt is induced by the proximity of the point of intersection to the curve, and when the tooth difference is fractional, as in some gear sectors, the required information can be obtained by the formulas preceding 28, or more rapidly and ordinarily precisely enough, by the following formulas based upon the tangents of the straight curves.

Where the number of teeth in the pinion is less than 50.84, the wheel must not have fewer teeth than:

$$T = 1.218t + 4.63 \tag{40}$$

Where the number of teeth in the wheel is less than 66.56, the pinion must not have fewer teeth than:

$$t = \frac{T - 4.63}{1.218} \tag{41}$$

Where the number of teeth in the pinion exceeds 50.84, the wheel must not have fewer teeth than:

$$T = 0.949t + 18.32 \tag{42}$$

Where the number of teeth in the wheel exceeds 66.56, the pinion must not have fewer teeth than:

$$t = \frac{T - 18.32}{0.949} \tag{43}$$

It is interesting to note that at about 310 teeth, the tooth difference remains nearly constant at about 2.5.

In standard systems, interference sets a downward limit to the number of teeth in the pinion, the number being 12 in 14½-deg. gears. If, however, the internal

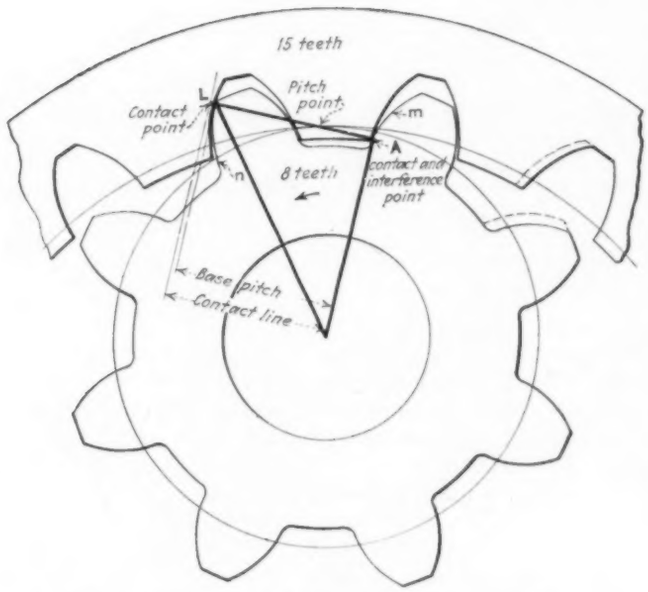

Fig. 5—A practical internal pinion cannot have fewer than eight teeth regardless of the number of teeth in the gear. The combination illustrated where an 8-tooth pinion meshes with a 15-tooth wheel is a limiting condition for 14½-deg. gears

diameter of the wheel be enlarged to that of the interference circle as explained and the root diameter be correspondingly increased, the limit is not set by interference, but by the necessity for continuous tooth action.

These diameters having been so increased, the minimum pinion to have continuous tooth action with any internal wheel is determinable in this way:

From Fig. 5, it will be clear that there can be continuous action only if the profile m enter the contact line LA at the same time as or before the profile n leaves it. The line LA, therefore, must be equal to or greater than the base pitch, as shown, and in the minimum pinion precisely equal.

The radius r of the minimum pinion is determinable by the formula, obvious from Fig. 6:

$$(r + 1)^2 = \pi^2 \cos^2\psi + r^2 \cos^2\psi$$

a formula identical with:

$$r = \operatorname{cosec}\psi \sqrt{\pi^2 \cos^2\psi - 1 + \operatorname{cosec}^2\psi} - \operatorname{cosec}^2\psi \qquad (44)$$

Substituting for the trigonometrical functions in this formula their known values we get that

$$2r = 7.39486 = t \qquad (45)$$

This value for t is independent of the number of teeth in the mating wheel though this, of course, must be such that trochoidal interference is absent. The minimum number of wheel teeth T is 13.64, as Graph III indicates and as Formulas 40 and 45 combined will prove. If t be given the smallest possible integral value, the minimum value for T is 15, and, therefore, Fig. 5 illustrates a really practical case, though a better design would be to decrease the pitch and increase the number of teeth in both gears.

Different pairs of standard internal gears may have:

(a) Neither involute nor trochoidal interference
(b) Both involute and trochoidal interference
(c) Involute but not trochoidal interference
(d) Trochoidal but not involute interference.

Since Graph II detects all combinations having involute interference, and Graph III all combinations with trochoidal interference, it follows that these two graphs used together will reveal every possible combination of usable pairs of purely involute 14½-deg. standard gears—to which they have been restricted.

Thus, if any selected pair of gears have the intersection of their ordinates on or above the curves of Graphs II and III (or in the unhatched portion of Graph I, which in effect combines the others), the inner circle of the wheel does not need enlarging. Since Graph III refers to combinations in which the internal diameter of the wheel is already equal to or greater than the involute interference circle, or has been enlarged to the diameter of that circle, it follows that all combinations of gears lying above the curve are employable.

But it does not follow that all combinations lying above the curve of Graph II are usable. Many of them indeed, though free from involute interference, suffer from trochoidal interference, as consultation of Graph III will show. To illustrate the method of using the graphs, a few examples will be given.

Example 1: To confirm an impression that a 82/108 standard pair will be free from both involute and trochoidal interference.

The ordinates, intersecting at a within the unhatched space of Graph I marked "no interference," justify this impression.

Example 2: Of a 115/128 pair, it is desired to learn whether, though the gears are large, the small tooth difference may induce interference.

Consulting Graph I, we see that the ordinates for this pair intersect well outside the involute interference curve (the straight line portion) but close to, if not on, the trochoidal interference curve, at b. This raises a doubt as to whether there is trochoidal interference or not. In such a case, we would turn to Graph III. Tracing the vertical ordinate for a 115-pinion, we note that it intersects the horizontal tooth-difference ordinate for 13 at b above the pinion curve, indicating that trochoidal interference is absent.

Example 3: In a 115/127 pair does the small tooth difference mean interference?

Here again the coordinates intersect so close to the trochoidal interference curve in Graph I as to raise a doubt. Graph III, however, distinctly reveals trochoidal interference for the intersection is at c well below the pinion curve. Graph III tells us, too, that the tooth difference must be at least 13.

Example 4: Does interference occur in a 40/51 pair?

Following the ordinates of Graph I to their point of intersection at d, we see immediately that both involute and trochoidal interference exist. The tooth difference is therefore too small.

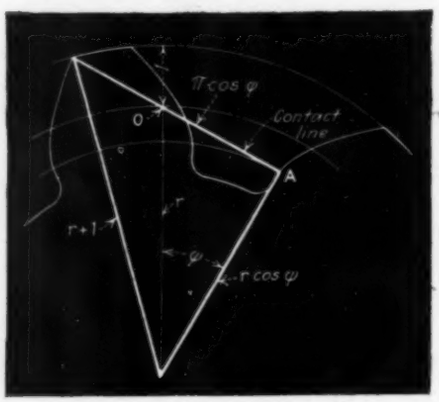

Fig. 6—The smallest pinion that will have continuous contact with any internal wheel is determined from the length of its line of contact. In the limiting case, this is just equal to the normal pitch

Example 5: Is a 40/53 pair free from interference?

The ordinates intersect at *e* in Graph I, disclosing involute interference. The inner circle of the wheel must be enlarged to coincide with the interference circle as calculated by Formula 3. Whether then the pair is free from trochoidal interference is doubtful from the same graph and Graph III must therefore be consulted. This consultation will show that trochoidal interference really exists and that, therefore, the tooth difference must be increased.

Example 6: If the tooth difference in the pair of the last example be increased to 14, will there still be interference?

Suppose, first, the pinion is reduced, the pair then being 39/53. Graph III now tells us that the co-ordinates intersect at *f* above the pinion curve and that, therefore, trochoidal interference is absent.

Suppose, second, the wheel is increased, the pair becoming 40/54. As the pinion has fewer than 62.79 teeth (see Graph II), the internal diameter of the wheel must be enlarged to avoid involute interference. Tracing vertically in Graph III along the 40-pinion line, we note that this line intersects the pinion curve well below *g* on the 14-difference line. Trochoidal interference, therefore, cannot exist, for the tooth difference is actually 14.

Example 7: Will a 30/180 pair have involute interference if both gears are of standard proportions? The tooth difference, being large, might lead to an assumption that all is well with the pair.

The involute rack of 14½-deg. pressure angle will engage just without interference with a 31.9 pinion (see top of Graph I). Interference increases as the rack bends into a gear, increasing with every decrease in the radius of the bend. Having fewer than 31.9 teeth, the pinion suffers from interference and the internal radius of the wheel must be increased as Formula 3 demands.

Example 8: Will a pair 50/67 have interference?

Graph I tells that there is no trochoidal interference, but that involute interference is doubtfully existent. As to involute interference Graph II is equally indefinite. Ordinarily in such cases, interference, if existent, could be ignored. Where precision is imperative, recourse for exact information must be had to Formula 3 in order that the standard internal radius might be checked against the radius of the interference circle. If the calculation indicates that the standard internal radius is less than the interference radius, it does not follow that it must be increased. Another remedy, if exactitude of ratio is unimportant, is to increase the number of the wheel's teeth. To decrease the pinion is not a remedy, for, as explained, with every decrease, interference increases.

Example 9: Is a 80/90 pair free from interference?

Unless the gears be equal (see the explanation preceding Formula 30), involute interference is not present if the pinion have more than 62.79 teeth (see Graph II), but trochoidal interference will exist in all combinations whose point of intersection falls within the wedge of Graph I. In the selected example, it will be seen, intersection is within this space, indicating that the tooth difference must be increased. Either the pinion may be decreased or the wheel increased.

Where the ratio cannot be altered, the remedy for trochoidal interference is to decrease the pitch and so increase the number of teeth in both members, a change increasing the tooth difference, as desired.

For gears beyond the capacity of gear shapers of the Fellows type demanding special cutters whose profiles must inevitably be drafted out, there is no good reason to adhere to any established tooth proportions, and advantage can always be taken of the necessity for laying out the forms so to proportion the teeth as best to meet strength considerations. In the pair of Fig. 5, for instance, the pinion's teeth would be thickened and the wheel's thinned to correspond.

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Filing and Chamfering

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WHEN ONE has an aluminum job to file, whether it is in the bench vise or smoothing up turned work in the lathe, the file will cut better, will not clog, and will give a finish comparable to polishing if it is dipped in lard oil occasionally.

In chamfering the cut-off ends of small rods to make a starting angle for a drive fit, a much smoother job will be had if the rods are held in a hand drill, or in a bit brace, and are revolved against a piece of fine abrasive cloth laid over a piece of thick felt on the bench. The work is, of course, to be held at the right angle.

• NEXT WEEK •

Time was when plunging, pounding, snorting horses were as inseparably connected with fire-fighting as the firemen themselves. Then came four metallic cylinders to take the place of the horses, and many a boy swore he would never follow another fire-engine to a fire. But now the leading manufacturer of fire-fighting equipment has put twelve- and sixteen-cylinder engines into production, and we suspect that small boys will follow them as willingly as they would horses. Next week the fathers of these small boys will be given complete data on the tooling and production of the twelve- and sixteen cylinder blocks. How this manufacturer adapted mass production methods to small lots will interest every manufacturer in the metal-working industry.

If space can be found for all of them, other features will include: an article by an industrial physician on cleanliness as a preventative of industrial diseases; gages with three-point contacts; teaching apprentices in Sweden; the multiple-tangent method of grinding a reflector punch; Reference Book Sheet on determining the weights of brass and steel rods and bars; final installment on the puzzling taper groove symposium.

• IN A. M. •

Wear Limits of Locomotive Parts

The practice of twelve railroads in regard to wear limits suggests that closer uniformity is as possible as it is desirable

THE practice on different railroads varies considerably as to the permissible wear before returning, reboring or otherwise machining such parts as cylinders, journals, crankpins, piston rods, valve stems and the like. In order to get a cross-section of general practice we have tabulated data from twelve railroads which at their request shall be nameless. These five tables cover 20 locomotive parts, and while the wear limits vary widely, they are of interest as showing a desire to maintain locomotives in good running condition.

It will be noted that railroad No. 1 gives much larger wear allowance than any of the others. This is probably because it runs in a sparsely settled district where schedules are slow, trains limited in number and revenues are correspondingly low. Needless to say the saving in shop costs is probably more than offset by greater expenditures for fuel and oil. Railroad No. 2, on the other hand, sets extremely small wear limits, while No. 11 has no wear allowance in many of the items, parts being refinished or replaced when they show any wear.

Table I

Railroad Number	Cylinders		Cylinder Bushings			Valve Chamber Bushings			Air Brake Pump			
	Rebore When Out of Round	Rebore When Out of Parallel	Rebore When Out of Round	Rebore When Out of Parallel	Renew When Over Size	Rebore When Out of Round	Rebore When Out of Parallel	Renew When Over Size	Rebore Air Cyl's When Out of Round	Rebore Air Cyl's When Out of Parallel	Rebore Steam Cyl's When Out of Round	Rebore Steam Cyl's When Out of Parallel
1	1/4	1/4	3/16	3/16	5/16 thick	1/8	1/8	3/16	1/16	1/16	3/32	3/32
2	0.032	0.032	0.032	0.032	0.500	0.002	0.002	0.125	Reground	in General	Repairs	
3	3/32	3/32	3/32	3/32	3/8	3/32	3/32	1/4	1/32*	1/32	1/32	1/32
4	1/16	1/16	1/16	1/16	3/8	1/32*	1/32	1/4	1/64*	1/64	1/32	1/32
5	3/32	3/32	3/32	3/32	1/2	1/16	1/16	1/2	1/32	1/32	1/16	1/16
6	1/16–3/32	1/16–3/32	1/16–3/32	1/16–3/32	3/4	1/64	1/64	1/4	1/64 H.P. 1/32 L.P.	1/32	1/32	1/32
7	1/32	1/32	1/16	1/16	3/4	0.006	0.006	3/4	1/64 H.P. 1/32 L.P.	1/64 H.P. 1/32 L.P.	1/32	1/32
8	All cyl's are bushed	All cyl's are bushed	1/16*	1/16*	1/2	1/32†	1/32†	1/4†	0.025	0.025	0.025	0.025
9	3/32	3/32	3/32	3/32	1/2	1/16‡	1/16‡	5/16‡	0.012	0.012	0.012	0.012
10	3/32 H.P. 1/8 L.P.	1/16	3/32 H.P. 1/8 L.P.	1/16	1/2	1/64	1/32	1/4	1/32*	1/32	1/32	1/32
11	1/16	1/16	1/16	1/16	5/8	§	x	1/4	Reground when any out of round			
12	0.03125	0.035	0.03125	0.035	0.500				0.03125	0.03125	0.03125	0.03125
			*= For back shops †= For round houses			*= Bushings bored in steps of 1/16 in. †= For back shop ‡= For round house §,x= Bored when any out of round			*= All air pump cylinders are ground			

Table II

Railroad Number	Piston Rods			Valve Stems			Valve Motion		Bull Rings	
	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Pins Renew When Under Size	Bushings Renew When Over Size	Piston Renew When Under Size	Valve Renew When Under Size
1	3/32	3/32	1/8	1/8	1/16	1/8	3/32	3/32	1/8	1/8
2	0.016*	0.016	0.250	0.002*	0.002	0.125	0.125*	0.008	0.125	0.093
3	1/32	1/32	1/4	1/32	1/32	3/16	3/32	3/32	1/8	3/32
4	1/32	1/32	1/4	1/64	1/64	3/16	1/8	1/16	3/16*	1/16
5	1/32	1/32	1/4	1/32	1/32	1/4	1/8	1/8	3/16	1/8
6	1/32*	1/32	3/8	1/32*	1/32	5/16	3/64†	3/64	3/16	3/32
7	0.006	0.006	1/4	0.006	0.006	1/8	0.010	0.010	3/32	1/16
8		No limit set	1/4§ 9/32	.....	.....	7/32‡ 1/4	1/16‡	1/16	1/32 1/4†	1/32 1/4†
9	0.010	0.010*	1/4	0.010	0.010*	1/4	0.025	0.025	3/16 1/4‡	1/8
10	1/32	1/32	1/4	1/32	1/32	1/4	1/32	1/16	3/16 1/4§	3/32
11	1/32	1/32	1/4	1/32	1/32	1/4	Renew when	under size	1/8	1/16
12	0.0156	0.0156	0.25	0.007	0.007	0.1875	0.023	0.023	0.125	0.03125
	*= Rods are ground ‡= No limit set—Ground in each shopping. §= Average allowance for round house repair			*= Stems are ground ‡= Average allowance for round house repair			*= Limit governed by size of pin †= Both are ground ‡= Renewal depends on total lost motion which is 1/4 in. max.		*= Round house repair allows 1/4 in. †= Large allowance for round house repair ‡= Below and above 29-in. cylinder §= High and low pressure cyls.	

Table III

Railroad Number	Main Journal			Other Journals			Driving Boxes	Crown Brasses	
	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Re-machine When Out of Parallel	Rebore When Larger Than Journal	Renew When Thickness is Less Than
1	3/16	3/16	3/8	3/8	3/8	1/2	3/16	1/8	1
2	0.004	0.004	3/8	0.01	0.010	3/8	0.002 per in. of diameter	Same as driving box	3/8 below new size
3	3/64	3/64	1/2	3/64	3/64	1/2	3/32	3/32	2
4	1/32	1/32	7/16	1/32	1/32	7/16	1/32	1/16	Usually at shoppings
5	1/32	1/32	1/2	1/32	1/32	3/4		1/16	1 1/2
6	1/32	1/32	1/2–3/4	1/32	1/32	1/2–3/4	1/32	1/16	
7	1/32	1/32	1/2	1/32	1/32	1/2	1/32	0.010* 0.025	1 1/2
8	1/64	1/32	1/2	1/32	1/32	1/2			
9	0.015	0.015	1/2	0.015	0.015	1/2–3/4*	0.015	3/64	1 1/2
10	1/32	1/16	1/2	1/32	1/16	1/2	1/16	1/16†	1 1/4–2 1/4*
11	No allowance	— Renew after under size	5 yrs or 1/2 in.	Same as f	or main journals				1 1/2
12	No special	allowance	3/8			1/2			1 1/4–1 7/8
						*= Depends on class of locomotive		*= Small figure for main journal. †= Electric loco. 1/8 in.	*= Varies with size of loco.

Some of the allowances given are astonishing, both as to the small amount stated as being permissible and the unusual figures given. These are understandable when they are practically decimal equivalents of small common fractions of an inch but in some cases they give the impression of having been set in the drafting room rather than in the shop. Knowing the comparatively large wear allowances permitted by some of the larger roads, which work out better in practice than might be imagined by those not familiar with railroad conditions, the extremely small allowances in a few cases seem unnecessary and unduly expensive.

Table IV

Railroad Number	Main Crank Pin			Other Crank Pins			Connecting Rod	
	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Re-turn When Out of Round	Re-turn When Out of Parallel	Renew When Under Size	Bush-ings Renew When Over Size	Eyes Rebore When Out of Round
1	1/16	1/8	7/8	1/8	1/8	3/8	1/8	1/8
2	Re	newed o	n general	repair		1/4	0.032*	0.005
3	3/64	3/64	3/32	3/64	3/64	5/32	3/32	3/64
4	1/32	1/32	*	1/32	1/32	1/4	1/16	1/32
5	1/32	1/32	1/4	1/32	1/32	1/32	1/8	1/16
6	1/32	1/32	1/4	1/32	1/32	1/4	1/16	1/32
7	1/32	1/32	1/4	1/32	1/32	1/4	1/16	1/32
8	1/32	1/32*	7/32 1/4†	1/32*	1/32	1 9/32 1/2*	I.C.C. li overall lo	mits for st motion
9	0.015	0.015	1/4	0.015	0.015	1/4	0.045	1/64*
10	3/64	3/64	1/4	3/64	3/64	3/8	3/32	1/32 Grind when worn appreci ably
11	1/32	1/32	5/16	1/32	1/32	5/16	1/16	
12	Turn all	pins on	ping	Turn all	pins on	ping	0.0932	0.0156
	* All outside pins		* Renew on class B or heavier repair † Round house repair	: All inside pins		* Round house repair	* Rolled	*Regrind for new bushing-

Another case of wide differences in practice is in Table III, where road No. 2 gives 0.004 in. as the permissible wear limit, while No. 1 allows 3/16 in. and 1/32 in. as general practice in five cases. Table IV also shows some startling variations, such as connecting rod eyes where the maximum is 1/8 in. and the minimum 0.005 in. Crosshead alignment in Table V also shows cases of wide variation. In this case road No. 1, which gives the widest limits in nearly every other item, is among those giving the smallest. Here roads Nos. 2 and 7 give a wear allowance of only 1/16 in. while others run up to 1/4 in. It would be of interest to know how closely these small limits are carried out in actual practice. The time of shopping usually determines many of the wear allowances actually followed. In other words general condition, not detail ones, usually govern.

Table V

	Eccentrics		Eccentric Straps		Rocker Shaft	Rocker Shaft Bushings	Cross-Head
	Re-turn When Out of Round	Renew When Under-Size	Re-turn When Out of Round	Renew When Over Size	Re-turn When Out of Round	Renew When Out of Round	Reline When Play Exceeds
1	3/16	1/2	3/16	1 1/8	3/16	3/16	3/32
2	0.015	0.188	0.015	0.188	0.032	0.032	0.063
3	3/32	1/4	3/32	3/4	1/32	3/32	1/8
4	3/64	1/2	1/16	3/4	1/32	1/32	1/4
5	*	1/4	1/16	3/4–1/2*	1/16	1/16	1/8
6	1/16	1/4	1/16	3/4	1/16	1/16	3/16
7	1/32	1/4	1/32	3/16	1/32	1/32	1/16
8	1/8	7/16–1/2	1/8	1/4†			3/16*
9	3/32	1/4	1/16	3/32‡			
10	3/16	5/16	1/4	1/4	3/16	1/8	1/8
11	1/16	1/16		3/16			
12	1/16	1/16	1/16	1/16	0.0468	0.0468	1/8
	* Do not re-turn			: Depends on Straps † Larger than ec-centric ‡ 3/16 in. sideplay			* Both vertical and hori-zontal—1/4 on switch engines

The footnotes under each table give interesting sidelights on some of the practices of different roads. Table I, for example, shows a variation in allowances for road No. 8, between repairs in the round houses and in the back shop. This table also notes that road No. 4 bores its valve chamber bushings in steps of 1/16 in., which permits an approach to standardization in repair work.

Comments on these practices by those who are interested in more uniform repair practices, the reasons on which shop standards of this kind are based, and other practical information that will aid in securing economical locomotive maintenance, will be appreciated.

IDEAS FROM PRACTICAL MEN

Short Cuts in Fitting Feather Keys

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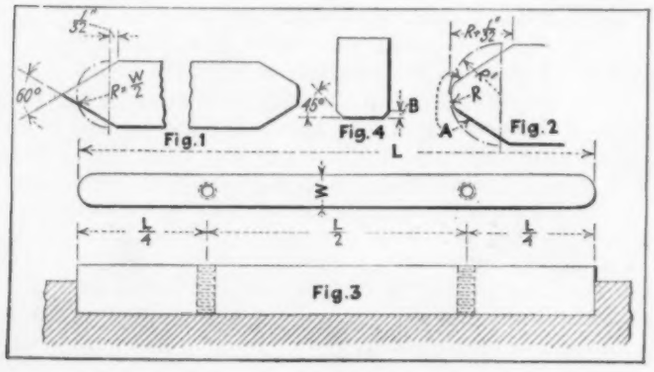
SPLINE or feather keys rely on friction to hold them in place. The requirements are that the depth of the slot in the shaft is equal to the width of the key, and that the key project above the shaft a distance equal to one-half its width. The key stock is from 0.001 to 0.002 over the width of the slot to insure a snug fit. The rounded ends of the key are filed or ground to suit the length of the slot, which should be milled just short of the key length to insure that there will be no end movement of the key.

In order to facilitate easier and quicker assembly, the rounded ends of the key should be slabbed off to 60 deg., included angle, the cuts to start $\frac{1}{32}$ in. inside of the radius center, as shown in Fig. 1. A small rounded surface is thus left at each end of the key, which alone should be touched up for the longitudinal fit. There is usually plenty of side surface left for friction. This leads to the assumption that specially rolled, round-ended key stock may be dispensed with and that standard rectangular stock can be used in its place, slabbing off the rounded ends as indicated at *A*, Fig. 2. The radius *R* may be anything up to R′ and may be obtained by simply filing or grinding off the corners.

During the assembling, or later in replacement, when it is necessary to remove the key, a hole should be drilled and tapped in the key into which a hexagon or a square head screw should be inserted. Turning this screw will result in jacking the key from its seat. In keys four inches long or over, it is advisable to have two holes, placed approximately as shown in Fig. 3. This method of removal is much more satisfactory than gripping the key in the vise, which will mar the sides so that they have to be dressed off before further assembling. The same key should not be placed in and removed from the slot too many times, as the shearing effect reduces the required friction in the final assembly.



Another kink that is not generally known is to touch off the lower or entering corners of the key, as shown in Fig. 4, looking at the end of the key. For small keys, the dimension *B* may be from $\frac{1}{64}$ to $\frac{1}{32}$ in., and on larger keys it may be from $\frac{1}{32}$ to $\frac{3}{64}$ in. The reason for beveling these corners is because the milling cutter does not stand up on the corners and cut a sharp-cornered slot. This is especially true when the slot is cut in a spline miller by a fish-tail cutter, the corners of the cutting edges being generally chamfered at an angle of 45 deg. If the keys are filed in the manner shown, a positive seat is assured and less dressing off of the tops will be necessary to permit them to enter the keyways without binding.

Where the duty is severe, it has been found advisable when using this type of key to make the height twice the width, sinking the key into the shaft one and one-half times its width and leaving the usual portion projecting. This gives greater leverage and tends to lessen the rolling action at the mouth of the slot. In most cases, this does not necessarily weaken the shaft to any great extent. Keys used to drive sliding gears should be ground on both sides to insure proper alignment and to guard against possible binding.

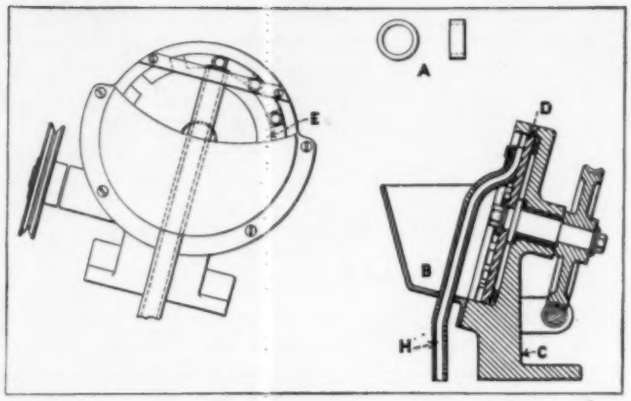
Hopper for Feeding Short Cylindrical Parts

JAMES R. CORNELIUS
Coventry, England

The hopper illustrated was designed for feeding short cylindrical bushings from one operation to another. Previously, the parts were fed by hand into a circular table that was indexed at each stroke of the press ram. This method necessitated great attention on the part of the operator, thereby reducing the possible output per press to the limits of safety for the operator.

The bushings, one of which can be seen at *A*, are approximately $\frac{1}{2}$ in. outside diameter and $\frac{1}{4}$ in. long. The automatic hopper consists of the container *B*; the pedestal *C*; the selector plate *D*; the retaining strip *E*; and the discharge chute *H*. The face of the pedestal is machined at an angle of 15 deg. from the vertical and is bored to receive the selector plate, this member being mounted on a shaft by which it is rotated through worm gearing. The selector plate is cup-shaped on its outer face, the depth of the flange being slightly in excess of the length of the bushings to be fed. Around the flange are cut a number of slots, the width of which is slightly in excess of the diameter of the bushings.

A strip is fitted inside the flange of the selector plate and is held stationary by means of a bracket fitted to the container in such a manner that any pieces that are lodged in the slots of the selector plate cannot fall out until they reach the opening presented by the discharge chute.



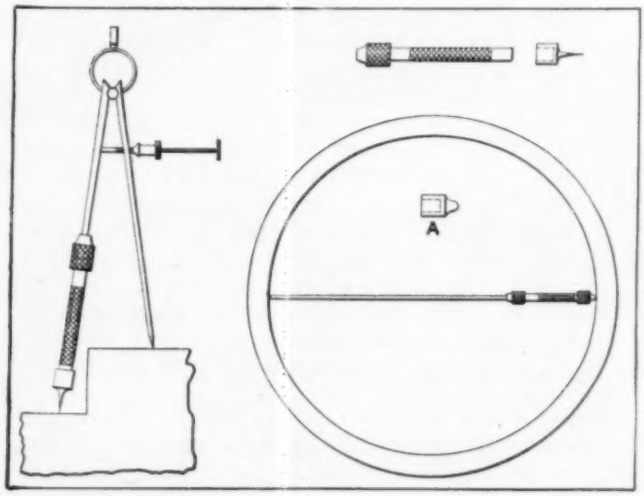
It will be seen that as the selector plate revolves, a certain number of bushings in the container will be caught in the slots as they move through the mass of parts. Those bushings that lie flat against the plate will be carried around to the discharge chute, while the ones that are lodged in any other position will either fall out before reaching this point, or be carried past the discharge chute and fall out there. By the use of this hopper, we were able to increase our output more than 150 per cent over the hand-feeding method.

Extension-Leg Dividers and a Substitute for Inside Mikes

JOHN AYRES

Nearly all machinist tool kits include one or two sizes of adjustable pin vises made on the principle of a spring collet, and small round-leg dividers, but not many include extension-leg dividers. Needing a pair of extension-leg dividers for a certain job, I improvised them as follows: I made a thimble to fit over the lower end of the hollow handle of a pin vise and soldered the pointed part of a needle to it. The pin vise was slipped over one leg of a pair of round-leg dividers and clamped, as shown in the illustration. It could be adjusted to suit the height of the step in the work.

In default of an inside mike, I made a thimble for the pin vise, but without the needle, as shown at *A*. By slipping a piece of drill rod shorter than the diameter of the hole to be calipered into the pin vise, I had an adjustable measuring wire with which I was able to get the measurement of the hole as accurately as with a more expensive tool. An outside mike was, of course, used to get the length of the "wire" after setting.

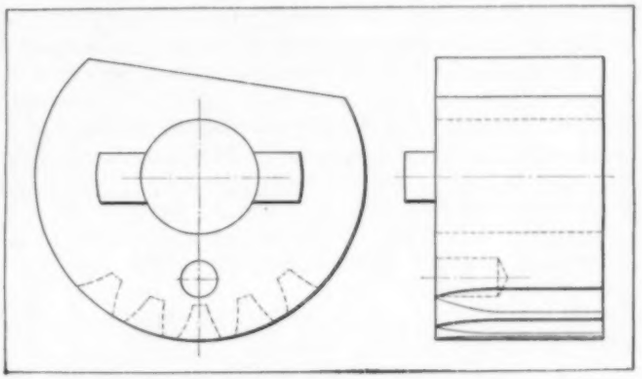


Burr Clearance in Tools

G. COLE

A mistake, which a great many tool designers make, is in not providing burr clearance on tools, which should be so designed that no burring of the work is necessary until after the last machining operation.

As an example, the gear segment illustrated has four operations after it comes from the screw machine; cutting the teeth, slabbing the flat, straddle milling the clutch jaws, and drilling the pin hole. In cutting the teeth and in slabbing the flat, burrs are formed on one side, therefore, burr clearance should be provided in the tools for straddle milling the clutch jaws and drilling the pin hole to clear the burrs formed previously.



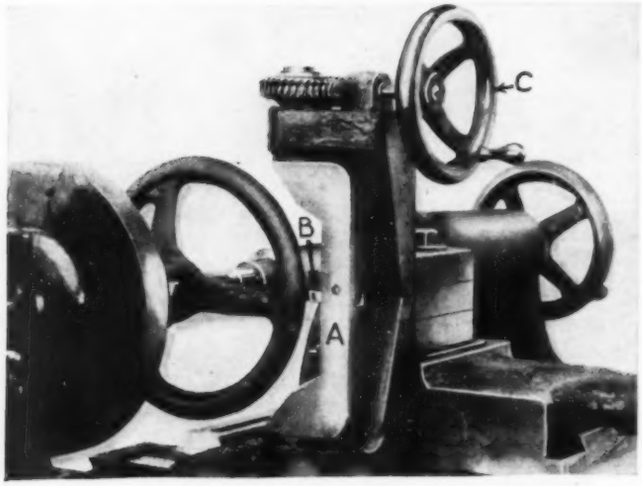
I know of instances where parts have been sent to the burring department after almost every operation, but after the tools had been provided with the necessary burr clearance, this excessive handling was eliminated, all the burring being done after completing the machining operations.

Fixture for Turning Handwheel Rims

A. E. GRANVILLE

Large shops having many handwheels to turn often do the job on a turret lathe or a heavy engine lathe, using form tools and plunge cuts. Small shops, having but a few handwheels to turn at infrequent intervals, seldom have machines rigid enough to do the job satisfactorily with such tools. Small shops can generally do a much better job with some kind of a turning device that will take rather light cuts and let the tool get under the scale. Such a device must enable the operator to produce a fairly smooth surface without too much doctoring.

An easily-made device for turning the rims of handwheels is shown in the illustration. It can be attached to the toolblock of almost any lathe by merely removing the toolpost and clamping the fixture in its place. There are no cross-pieces on the saddle to bother with and no holes to drill and tap, yet the fixture is rigid enough to produce a good job on any handwheel within its capacity.



Another advantage, seldom found in similar devices, is that it can be used for turning balls or other work having spherical surfaces.

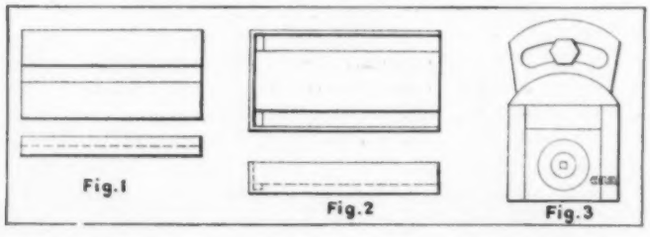
The trunnioned steel piece *A* is carried in a heavy cast-iron bracket bolted to the toolblock, as shown. The trunnioned piece holds the turning tool *B*, which may be slid in or out to suit the radius of the work. A clamping screw only is necessary to lock the tool, although if one cares to go to the expense, an adjusting slide may be incorporated. To the upper trunnion is attached a wormwheel, operated by a worm through the handwheel *C*. It will readily be understood that by turning the handwheel, the tool will be made to describe an arc. The various parts are, of course, set rather tight so as to prevent the tool from digging in. After the handwheel has been turned, the carriage is run back, the lathe speeded up, and the rim finished with a piece of abrasive cloth held to the work by hand.

Cutting Slots in the Shaper—*Discussion*

ROBERT S. ALEXANDER

Having had considerable experience in shaper work, I was much interested in the article by Theodore Kruger under the title given above (*AM*—Vol. 75, page 642). While Mr. Kruger's method of reversing the toolholder has much to recommend it where the slot goes clear through the work, as in Fig. 1, it must be obvious that the same method cannot be used in such a case as is shown in Fig. 2. Recently, I had to do such a job in shaping a cast-steel slide block, using the conventional toolholder and toolbit.

Before starting work of this nature, I always see that the ram gibs are properly adjusted, as tool chatter and breakage are often traceable to this point. Next, I secure the clapper to the clapper box by drilling and tapping a hole through the edge of the box and into the clapper, inserting a safety setscrew, as indicated in Fig. 3. This in effect, transforms the shaper into a horizontal slotter. By this method, with a tool ground to the correct clearance, no difficulty is experienced in handling a variety of slotted work, including dovetailing.

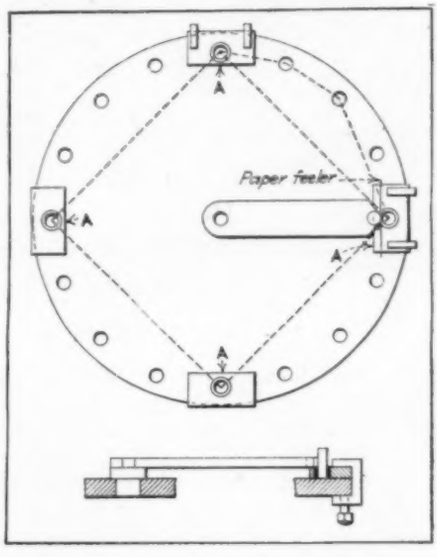


Spacing Holes in a Circle

FRANK A. GABRIEL

Recently, we had the job of making a jig for drilling sixteen holes equally spaced in a 48-in. circle. As our toolroom is small and the equipment is limited, we resorted to the following method for making the bushing plate:

Four small cast-iron blocks were bored for bushings that were accurately ground and lapped. Then we made a radius bar having a plug at one end to fit the central hole in the bushing plate. In the other end of the radius bar, a hole was drilled and reamed of the same size as the holes in the bushings, the center distance from the plug being equal to the center distance between the central hole and the holes to be drilled in the bushing plate, minus the diameter of the holes to be drilled. This distance was measured by Jo blocks. A plug was pressed in this hole and the end of the radius bar was cut away to permit part of the cylindrical surface of the plug to protrude.



The bushing plate was laid out as nearly accurate as was possible by ordinary means and circles were scribed at the approximate locations of the holes to be drilled. The four blocks *A* were clamped to the bushing plate approximately 90 deg. apart, as indicated in the sketch, the blocks being set by the circles just scribed. Plugs were inserted in the bushings in the blocks. By the use of the radius bar and an inside micrometer, the blocks were set so that the plugs were at the correct radial distance and at 90 deg. apart. A paper feeler was used between the plug in the radius bar and the plugs in the bushings. The bushing plate was clamped to the table of a radial drill and aligned so that the bushing in one block was in line with the spindle, using an indicator. Then the first hole was drilled and reamed. For the second hole, the bushing plate was rotated until the next bushing indicated accurate alignment with the spindle. The same procedure was followed for the third and fourth holes.

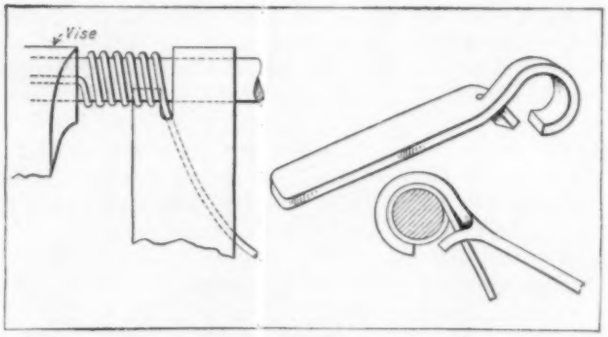
After the first four holes had been drilled and reamed, the blocks were moved 45 deg. bringing them 90 deg. apart as before. They were set for radial distance by

the radius bar and for angular distance by an inside micrometer. For the third and fourth series of holes, the blocks were moved 22½ and 45 deg., respectively, being located by the means described. All departures were taken from the plug in one block, thus eliminating the chance for cumulative errors. The results were highly satisfactory.

Hand Tool for Winding Springs

GEORGE ARTHUR LUERS
Consulting Engineer

Winding a spring is not difficult if a prong tool of the simple construction shown in the illustration is used. In conjunction with a bench vise and a rod, the tool will be found to be a quick means for winding a spring from almost any size of steel or brass wire. A couple of these tools of different sizes will be a desirable sup-



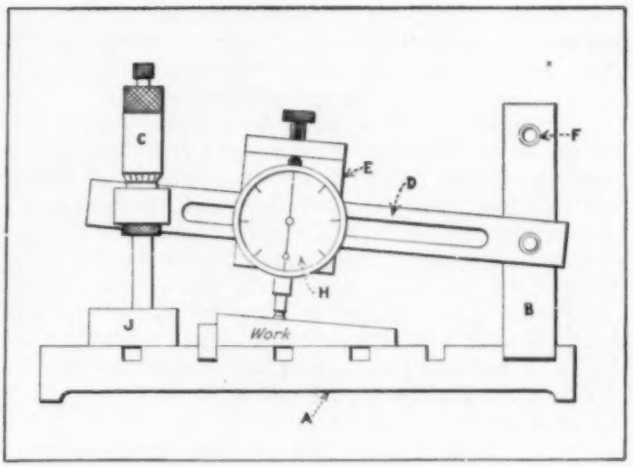
plement to any toolkit, providing a means for quickly winding a spring when one is wanted. The tool is made from flat stock and should be at least ¼ in. in thickness for winding springs from wire up to ⅛ in. in diameter. For smaller wire thinner stock can be used.

Fixture for Checking Angular Work

CHARLES KUGLER

For checking small angular parts, the fixture illustrated can be recommended. It consists of the base *A*; the support *B*; the micrometer head *C*; the bar *D*; the sliding head *E*; the dial indicator *H*; and the block *J*. Parallel slots are machined in the base for keys to act as stops for the work. The two bushings in the support *B* are for pivot pins for the bar *D*, and their center distance is equal to the range of the micrometer head. The micrometer head is held in a collar pivoted to the bar *D*, so that its axis is always at a right angle to the base. The sliding head carries the dial indicator and can be traversed along the bar *D*. The block *J* is of a thickness that will bring the bar *D* parallel with the base when the micrometer reads zero. The dial indicator can be adjusted vertically by a screw at the top of the sliding head.

In operation, the fixture works like a sine bar in which the center distance between the pivot and the micrometer head represents the hypotenuse of a right-angle triangle having a radius of 10 in. The angle of the work shown is 4 deg., and the micrometer must be set at a height equal to that of the side adjacent, which in this case is



0.6976 in. The spindle of the dial indicator is brought into contact with the work and the sliding head is traversed along the bar. If the indicator needle remains stationary, the angle of the work is correct.

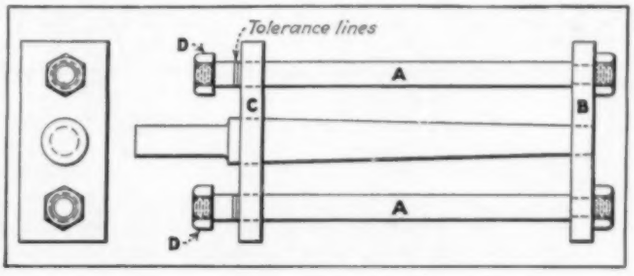
With work thicker than can be checked with the bar pivoted in the lower bushing in the support, the bar must be pivoted in the the upper bushing and the block *J* stood on one end, its length being equal to its thickness plus the center distance of the bushings in the support. When the quantity and the quality of the work warrants, all of the parts should be hardened and ground.

A Simple Taper Gage

H. M. DARLING
Engineer, Wells Manufacturing Company

Most gaging of taper pins, reamers, blanks, etc., is done in gages made up of two straight-edges set at the correct angle and distance apart to suit the work in hand. While gages of this type are good for most work, it requires considerable "squinting" to see if the work fits closely enough to shut out daylight. Sleeve or female gages are also used a great deal, but require the use of chalk, prussian blue, or a nice sense of feel. Both of these types of gages are rather slow when used on production work.

The accompanying sketch shows a gage that not only gages the work at both ends, but also checks the distance between the gaging diameters. Referring to the sketch, the rods *A-A* are shouldered and are held by nuts in the plate *B*. The plate *C* is a sliding fit on the rods, but is prevented from coming off them by the retaining nuts *D-D*. The sketch shows a reamer blank in gaging position, and it will be seen that the plate *B* has a hole in it for the correct size of the small end of the reamer. The plate *C* has a hole in it for the correct size of the large



end of the work. The tolerance lines on the rods give the correct distance between the gaging diameters.

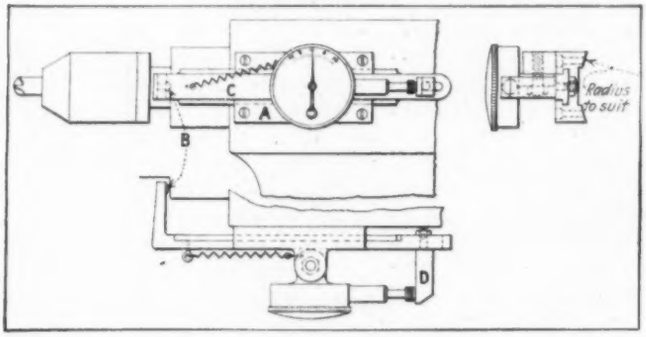
In use, the work is inserted through the hole in the plate *C* and the small end is pushed into the hole in plate *B*. Then the plate *C* is run up on the work until it bears on the large diameter. If the taper and the diameters are correct, the side of the plate *C* will stand between the tolerance lines on the rods. The handiest way to to use the gage is to hold the first and second fingers under the sliding plate *C* and place the thumb against the end of the work, pushing it into place. On real production jobs, tapers can be gaged faster and more accurately with this gage than with any other type with which I am familiar. All parts should be hardened for accuracy and long wear.

A Dial Indicator Depth Stop

WM. C. BETZ
The Fafnir Bearing Company

For accurate gaging the depth of cherrying, drilling or counterboring repetitive work in the lathe, the stop illustrated will be found to be useful.

The body *A* is attached to the barrel of the tailstock by screws in such position that the face of the dial indicator is in line with the operator's vision. The contact



button *B* on slide *C* is held against the end of the tailstock spindle at all times by the tension of a helical spring. The dial indicator is clamped to a lug on the body *A*. With the tool set for the correct depth, the contact piece *D* at the right-hand end of the slide *C* is brought against the indicator spindle until the needle makes one revolution, stopping at zero.

In operation, the tailstock spindle is advanced, feeding the tool to the work. Before the correct depth has been reached the indicator needle will commence to move. When the needle reaches zero the tool has cut to the correct depth.

SEEN AND HEARD

JOHN R. GODFREY

High Speed Cuts Airplane Wings

High-speed airplanes present many new problems in both design and construction. Driving a plane through the air at 200 m.p.h. or better cuts or wears the leading edge of the wings and other surfaces in an unbelievable manner. Even the protecting covering of sheet aluminum or Dural cuts out very quickly. Much of this is probably due to the dirt kicked into the air by the propeller when on or near the ground. But there are probably more fine particles in the upper air than we realize. And at a speed of from 150 to 200 feet per second almost anything in the air will act as an abrasive. There are still many chances for improvement in airplane construction.

Abrasive in Cylinder Walls

There is still a bit of educating to be done by the builders of grinding machines for cylinders and other bearings, for the idea that particles of abrasive stick to or are forced into the walls still prevails in some quarters. One reconditioner of decrepit motors told me of the test he made to prove his case. He let the agent who was trying to sell him the hone finish one cylinder bore. Then he put his boring tool on the same cylinder and cut out about two thousandths on each side. He caught all the chips and had them analyzed for abrasive —and found it—or thinks he did.

In view of the fact that practically every automobile cylinder is honed, it is hardly likely that his test proved anything. Or perhaps a little abrasive may help wear in the rings and pistons for the same reason that an old engineer I knew never let the engine builder take a smooth cut through the cylinder. He wanted the tool mark ridges to help wear in his piston rings.

With motor life increasing in spite of honed cylinders, perhaps the abrasive advocates need not worry if an occasional repair man does think it is all wrong.

Seeing Through Metal

We have long known that we could see light through the thinner sheets of gold leaf, but now comes a nickel leaf or foil so thin that print can be read through five thicknesses spaced a few millimeters apart. The leaf was displayed in London at a recent exhibition and is made by electrodepositing nickel on copper, then copper on the nickel. The copper is then dissolved from this metal sandwich. It is necessary to plate the nickel on both sides in order to prevent its rupture from unequal stresses when the copper is removed.

A Double-Acting Salvage Plan

An idea almost as useful as the Chinese plan of hiring a doctor to keep one well underlies a salvage plan used in a certain moderate sized shop. Each day all scrap rejected by inspection is gathered into a heap and is postmortemed by one engineer and one inspector detailed for the purpose.

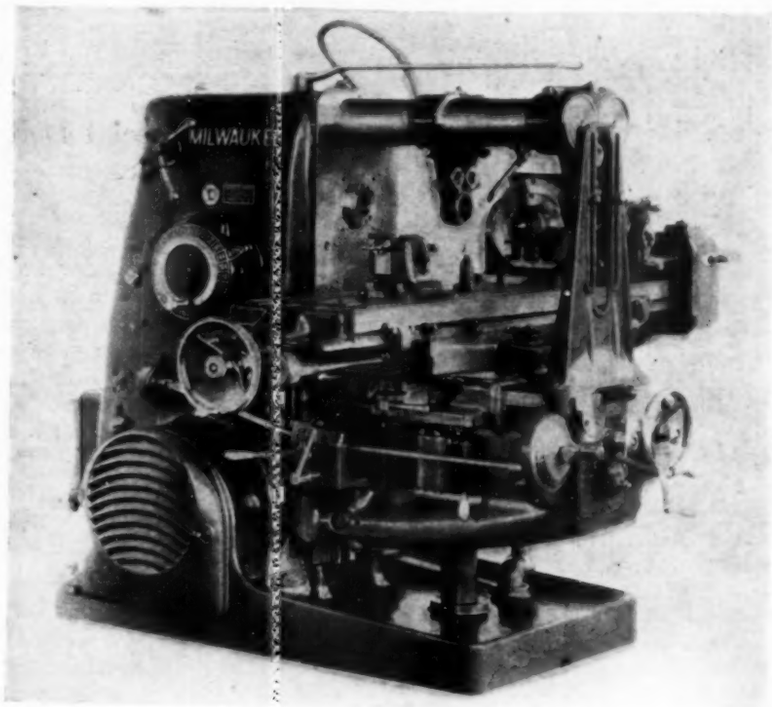
The first object is to salvage the scrap, if possible, but equally important is the effort to prevent the production of further scrap by changing the design. Unfortunately, many a draftsman is more interested in making a beautiful drawing of a part that will function than in designing something that is easy to make.

One of the prize exhibits in this shop is the salvaging of two tons of parts that were scrapped because someone in the engineering department specified a length tolerance that was needlessly close. A permanent change in the tolerance salvaged the scrapped parts and prevented a recurrence.

SHOP EQUIPMENT NEWS

"Milwaukee" Nos. 3 and 4 Milling Machines

Kearney & Trecker Corp., Milwaukee, Wis., has added the Nos. 3 and 4 machines to its line of improved style knee-type milling machines. The line is now available in four sizes, each of which is built in the universal, plain, and manufacturing horizontal types, and in the plain and manufacturing sliding-head vertical types. Construction details of



the Nos. 3 and 4 are the same as those of the Nos. 1 and 2 (*AM*—Vol. 75, p. 184).

Features of the line include a range of spindle speeds from 12 to 1,200 r.p.m.; feeds from ¼ to 60 in. per min.; a center-bearing spindle with worm drive; a sponson-type knee; and a multiple V-belt drive.

The 100 to 1 speed range permits surface speeds in either direction as low as 50 ft. per min. for a 12½-in. cutter, and as high as 100 ft. per min. for a ¼-in. cutter. This range makes possible better performance with high-speed steel cutters, as well as permitting full use of tungsten and tantalum carbide cutters. The 27 speed changes provided are in geometrical progression, obtainable by a single lever in combination with a large direct-reading dial. This range is divided into three series of nine speeds each. Three bearings support the spindle to give greater stiffness. The front and center bearings are arranged to take both radial and thrust loads, while the rear bearing is of the straight roller type.

The knee is a H-type box section, with inclosed walls and heavy projections at the bottom of each side in the form of sponsons. Knee and column are locked by a clamp operated by a handle at the side of the knee. An individual oil pump is fitted to the knee to give automatic flooded lubrication. The saddle is provided with a large center rib, which gives maximum strength without excessive height between the top of the knee and the top of the table.

The spindle on both the Nos. 3 and 4 machines is only 51 in. above the floor. Double overarms are 5¼ in. in diameter. A star wheel on the left side permits easy in and out movement of the overarms. Two arbor supports are supplied, the outer one solid and the center one split in two halves. Each half is bored to fit one of the overarms, and the halves lock together by a long bolt. When it is desired to remove the arbor, each half of the arbor support is swung around its respective overarm and the arbor can be removed with the cutter set-up intact.

Power Rapid Traverse

Power rapid traverse in six directions is provided. Engagement of the rapid traverse does not disengage the feed, and when the handle is released the feed automatically picks up where the rapid traverse ends. As a safety measure, when the rapid traverse is being used to run the work up to the cutter, the table dog releases the clutch and the feed is then reengaged by the reverse lever. Rapid traverse rate for the longitudinal travel of the table and saddle is 150 in. per min., and for the knee 75 in. per min.

In the manufacturing-type machines the speed and feed changes are made by means of pickoff gears. The feed range has 24 changes from ¼ to 60 in. per min. The sliding head vertical machine is furnished either as a plain machine with 27 speed and feed changes through a quick-change mechanism, or as a manufacturing machine. The head has 8 in. of vertical travel, and can be furnished with power feed and rapid traverse. A 4-step, dial-indicator precision stop can be provided so that step milling can be carried out.

The Nos. 3 and 4 universal machines are equipped with a 14-in. swing hypoid bevel-gear dividing head, which is designed to give leads for cutting threads as fine as 38 threads per in., as well as leads up to 2900 in. in one turn. Circular milling is possible, since the dividing head can be revolved by power without engagement of the table screw. The dividing head then becomes a rotary

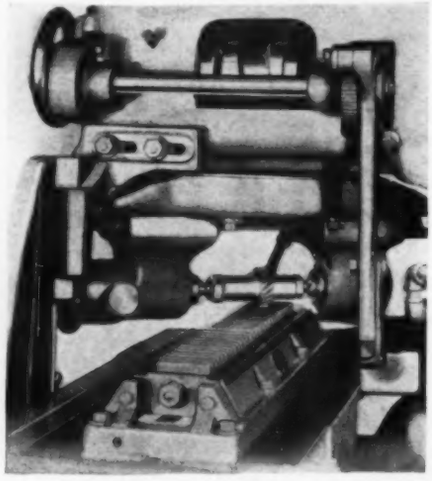
table, operating with the spindle horizontal, vertical or at any intermediate angle. Range of the No. 3 machine is: longitudinal feed 34 in.; cross feed, 12 in. and vertical feed, 18 in. Range for the No. 4 machine is: longitudinal feed, 42 in.: cross feed, 14 in. and vertical feed, 18 in. Net weights for the various models range from 8,975 to 10,525 lb.

Michigan Gear Finishing Machine

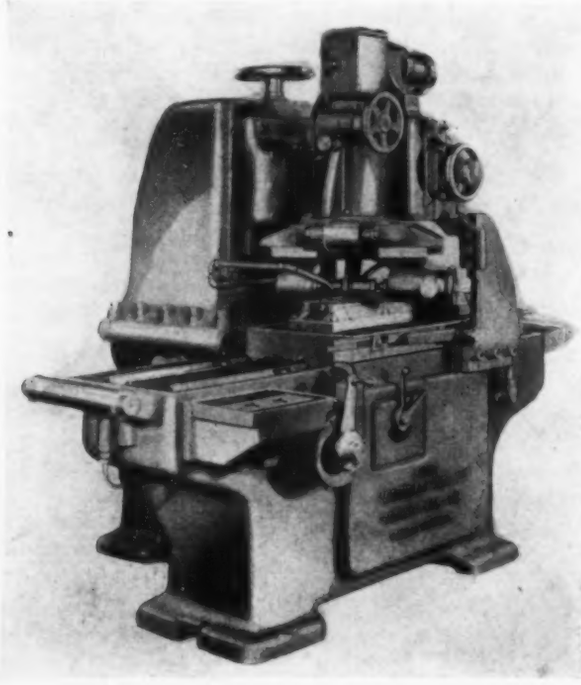
Both helical and spur gears can be finished on the hydraulic gear finishing machine announced by the Michigan Tool Co., 7171 Six Mile Rd., Detroit, Mich. The amount of stock left for this operation should be between 0.005 and 0.010 in. on the tooth thickness. Any helix angle, right or left, can be finished on the same cutting rack, providing the pitch and pressure angle are the same. The machine is so constructed that the head can be set either right or left to a 55-deg. helix angle.

Two hydraulic circuits are used in this machine. The high-pressure circuit provides power for the table travel and the low-pressure cylinder, mounted on the top of the head is used to raise and lower the head, and to lock the machine to the correct finishing dimension while the gear is finished. The head is fed into the gear under a definite pressure with the intention that if a gear has an excessive amount of stock the cutting rack will not be broken or the machine stalled.

The operator places the gear on an arbor or centers and pushes one lever. The head automatically starts downward to the predetermined position, and the table then makes a predetermined number of strokes, from one to fifty, depending upon the size of the gear to be finished. The head then raises automatically and the table stops so that the operator may remove the finished gear and insert another. By using two arbors, one can be loaded while the other is in the machine. A place is provided on the side of the machine to hold the spare



Rack box and head from the rear of machine



arbor to permit the oil to drain into the oil tank. When the gear is mounted on the arbor between centers and is in engagement with the cutter rack teeth, a shaving action is developed on the pitch line as well as over the complete tooth face. A spiral gear is set at the proper helix angle and run over a spur rack. Likewise, spur gears are finished on a spiral rack. The cutter rack is made up of individual cutter blades, lapped and assembled with a positive locking device in the rack box. These blades are made individually and lapped to a tolerance of 0.00003 in. Serrations are ground in the cutting faces of the blades to form cutting edges.

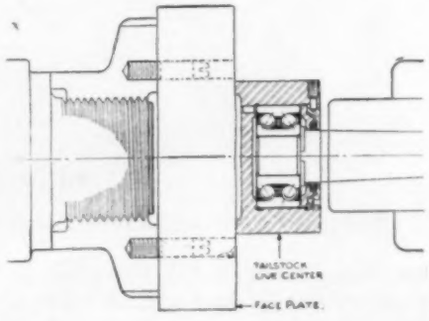
Production time on a 28-tooth, 10-pitch gear, 40-deg. helix angle, $\frac{3}{4}$-in. face, and with 0.004 to 0.008-in. stock on the tooth thickness, is 60 per hour. Limits on the gears finished are 0.0015 in. eccentricity, 0.0002 in. on the involute, 0.0002 per in. on the helix angle, and 0.0002 in. on tooth spacing, while an 85 per cent contact of the full tooth form is obtained.

For cluster gears, where the diameters are different and the gears are spaced close together, such as $\frac{3}{8}$ in., it is necessary to build a special rack. However, if the gears are 1 in. or more apart, they can be finished on a standard cutting rack even though the diameters vary.

Standard spur blades for finishing helical gears are available in 5 pitch and coarser as special and up to 10 pitch and finer as standard. Standard spiral rack blades for finishing spur gears are made in the same range.

"Red-E" Special Ball Bearing Center

A special ball-bearing center has been brought out by The Ready Tool Co., Bridgeport, Conn., for holding work up to the faceplate in a lathe where such work can not be held on an arbor for turning the outside diameter or periphery. This center has a special head quite large in diameter and fully relieved, except for a circle

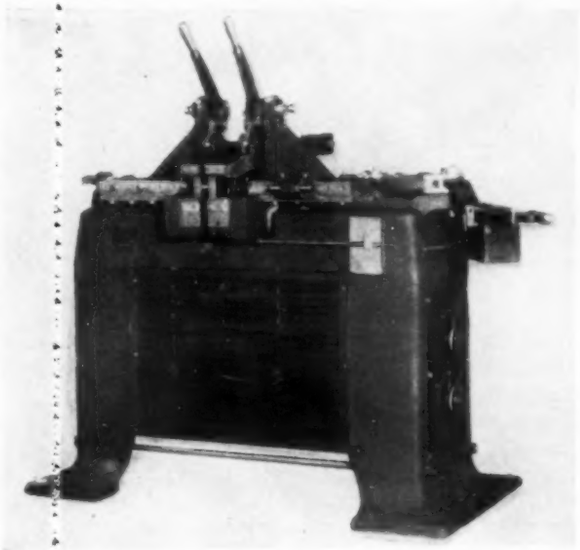


about $\frac{3}{8}$-in. face. It has a New Departure preloaded bearing, and the tailstock center can be held so that the work will be safely held against the faceplate. Generally one or more holes are put in the work towards the outside diameter, and a driving pin in the faceplate engages the hole. The center holds the work up firmly

against the faceplate to enable the outside diameter or periphery to be turned at one setting in place of by the usual method of doubling chucking.

"Standard" Type B Butt Welder

A butt welder of light and medium capacity for production work has been announced by the Lenney Machine & Mfg. Co., Warren, Ohio. This Type B welder has backup and spacing arms easily adjustable and furnished as standard equipment. The welding lever on the hand-operated machines carries a contact switch operated from a thumb latch, so that the current may be turned on or off at will. Another switch is located inside the frame, operating from a trip on the sliding head. This switch automatically breaks the circuit at any predetermined point.

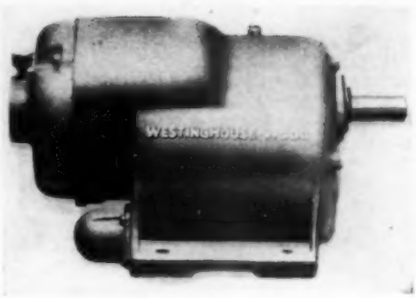


The upset is by a single toggle movement. Die opening is 2 in., and total adjustment between dies is 3½ in. Current regulation is in 12 steps. The transformer is mounted as close as possible to the electrodes, and is protected from flash. The baseplate is extra heavy with tierod reinforcing. The butt welder operates on single-phase current only and on any voltage or frequency. It is regularly furnished for 220 or 440 volts, 60 cycles. Capacities range from 25 to 100 kva.

Westinghouse-Wood Electric Motor Gear Units

The H. C. Wood Machine Works, 514 Bryant St., San Francisco, Calif., has brought out Westinghouse-Wood electric motor gear units composed of Westinghouse electric motor parts combined with helical gears held in place by oversized ball bearings. These units are compact and are slightly larger than the ordinary motor. The base measures 9x12 in.

The units may be obtained to give 900 to 60 r.p.m. on the outgoing shaft,



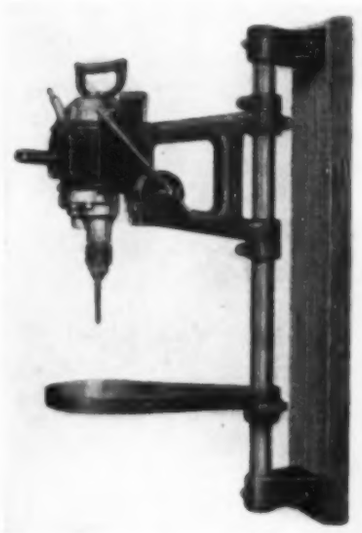
using an 1,800 r.p.m. motor, or any speed down to 30 r.p.m., using a 900 r.p.m. motor. A slow-speed shaft can be had on one end of the motor and a standard-speed shaft on the opposite end. The motors can be furnished in polyphase, single phase, or d.c. designs without changing the mounting dimensions. Sizes from ½ to 7½ hp. are carried in stock.

"Oxweld" No. 25M Bronze Welding Rod

The Linde Air Products Co., 30 E. 42nd St., New York, N. Y., has introduced the "Oxweld" No. 25M bronze welding rod for use in rebuilding wear-resisting surfaces. The rod is non-fuming and free-flowing. It is possible to remelt and reweld welds made with this welding rod, which is effective for use in the sectional building-up of large pieces, where the weld must be made in successive layers. No heavy slag is formed over the weld after it has cooled. The hardness of the weld metal is 96 Brinell. Three sizes supplied are $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in.

Hisey Post-Type Radial Portable Drillstand

The Hisey-Wolf Machine Co., Cincinnati, Ohio, has introduced the post-type radial drillstand with a sensitive rack and pinion feed adjustment for use with all Hisey portable electric drills up to and including $\frac{7}{8}$ in. capacity. The motor-holding brackets are designed so that the portable drill can be attached without removing a single part. General specifications are as follows: vertical adjustment (without resetting) by means of rack and pinion, 7½ in.; vertical adjustment, 19 in.; diameter of column, 2 in.; swing of arm, 240 deg.; maximum reach of arm, 13 in.; net weight, 140 lb.



Kling Friction Saw—*Correction*

An error was made in the announcement (*A.M.*, Vol. 76, p. 349) of the purchase of the complete line of high-speed friction saws from Joseph T. Ryerson & Son, Inc., by Kling Bros. Engineering Works, Chicago. The statement was made that the Bryant Machinery & Engineering Co., Chicago, will act as general distributor for the Kling Works for this saw as well as the complete line of heavy-duty punches, bending rolls, special grinding equipment and plate machines. On the contrary, Jos. T. Ryerson & Son, Inc., retains the exclusive sales rights on all Kling equipment except the high-speed friction saws and special grinding equipment. The Bryant Machinery & Engineering Co. will act as general

distributor for the friction saws, and Ryerson will continue as selling agents for these saws in the principal industrial areas.

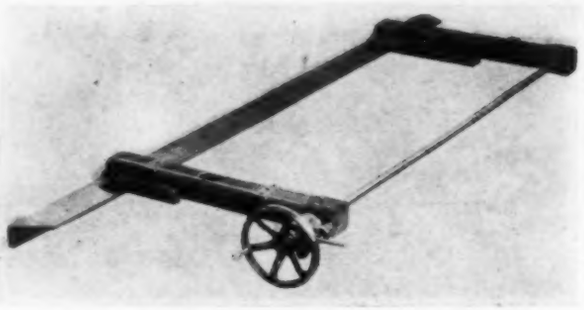
"Alternarc" Arc Cutting Saw

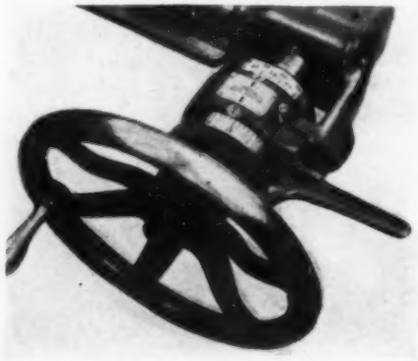
An arc cutting saw in which the cutting wheel is one electrode and the work is the other electrode has been introduced by the Electric Arc Cutting & Welding Co., 152-160 Jelliff Ave., Newark, N. J. A current of several hundred amperes at a low voltage passes between the cutting wheel and the work, the wheel revolving and pressing a new and cool surface to the work. The work is melted and eaten away evenly and rapidly. Either a.c. or d.c. can be used. For mild steel, the cutting wheel is used, and it does not wear out it is claimed. The surface gradually gets larger because of loading and has to be reshaved to the original dimension. For certain types of alloys, carbon and other wheels are used. The wheel has to be driven rapidly in order to clear out the cut section. Speeds above 1,800 r.p.m. are best.

Improved Back Gages for "Cincinnati" All-Steel Shears

The Cincinnati Shaper Co., Elam St. & Garrard Ave., Cincinnati, Ohio, has developed an improved type of back gage for its all-steel shears (*AM*—Vol. 75, p. 676). These heavy, ball-bearing, direct-reading back gages have adjusting screws connected to work in unison. If the gage is aligned parallel with the knives, it maintains this alignment for all settings. One end of the straight edge is adjustable outward, independent of the screw for taper cutting. The gage bar abuts a stop in the parallel position. All bevel gears are mounted on ball bearings. The direct-reading dial is graduated in inches and sixty-fourths. An automatic locking device locks the gages for any setting.

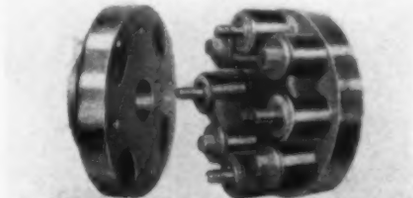
Right — The improved back gage for Cincinnati All-Steel Shears has adjusting screws working in unison, but one end of the straight edge is adjustable for taper cutting. Below—The direct reading dial is graduated in inches and 64ths





"F.A.B." Flexible Coupling

A shock-resisting feature and a method of eliminating vibration are embodied in the flexible couplings developed by the F. A. B. Mfg. Co., 67th & Vallejo Sts., Oakland, Calif. These features are in addition to those compensating for parallel and angular misalignment, or combinations of both. No lubrication is required for these couplings, and they will operate at speeds up to 3,450 r.p.m. without noise. Sizes are manufactured for transmitting to 1,200 hp.

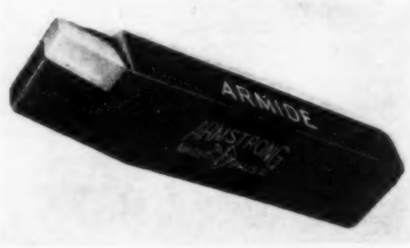


Type R Rubber Bushed Coupling

Type SL Leather Disc Coupling

"Armide" Cutters

A new type of cutting carbide, said to be an alloy, is used in the "Armide" cutters announced by the Armstrong Bros. Tool Co., 317-357 N. Francisco Ave., Chicago, Ill. This Armide cutting carbide has a hardness of from 88.5 to 90.5 Rockwell C scale and a tensile strength of 250,000 lb. per sq.in. Thermal conductivity is low so that the tool remains cool and securely brazed even though chips run red hot. The edges are claimed not to groove because Armide will not alloy with iron or steel. Thus, the material permits stronger cutting angles and higher running speeds.



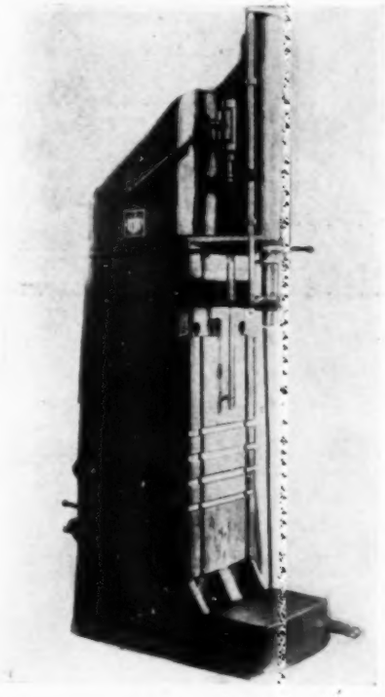
Armide-tipped bits are made in two types and in five ready-ground cutter forms. All forms are available in either flat or square bodies. The five standard cutter forms are right-hand turning and facing, left-hand turning and facing, square nose, round nose, and 60-deg. threading. The squares are made in $\frac{1}{4}$ to $\frac{5}{8}$ in. and the flats in $\frac{1}{4}$x$\frac{3}{8}$ to $\frac{5}{8}$x$\frac{7}{8}$ in.

Toolholders especially designed for use with these cutters are heavy-necked and hold the cutters without

tool angle—parallel to the toolholder shank. The lower part of the head of these toolholders is undershot, and extends forward under the cutter bit so that the cutting edge is closely supported. Toolholders come with straight, right-hand offset, and left-hand offset shanks made in two types. The first type, recommended for general lathe, planer and shaper use, is broached to take flat cutter bits, and the second, square bits.

"American" 6- and 12-Ton Hydraulic Horning Presses

Hydraulic horning presses in 6- and 12-ton sizes have been announced by the American Broach & Machine Co., Ann Arbor, Mich. The machine is operated by hydraulic feed, the hydraulic pumping unit being manufactured by the company. It is



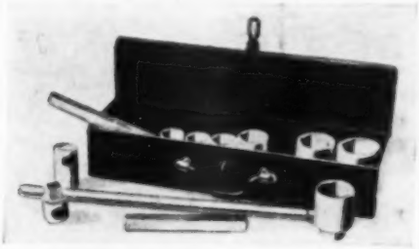
located directly in the rear of the column, the column itself serving as an oil reservoir. The pump unit is equipped with a built-in relief valve and volume control, the latter varying the speed of the ram. A four-way balanced piston valve may be controlled by foot or hand lever. Knock-off shafts with adjustable dogs are provided so that the stroke can be set to any desired length.

The front face of the column and the floor plate are machined to receive fixtures or special tables. Various forms of tables can be supplied. The end of the ram is tapped 2 in., 8 pitch to receive standard connections.

Specifications of the 6-ton horning press are: Stroke, 21 in.; distance from ram to finished surface, 9¼ in.; height of finished surface on base from floor, 8 in.; maximum daylight between finished surface on floor plate to ram, 51 in.; down speed of ram, 20 ft. per min., and weight of machine, 3,900 lb. Specifications of the 12-ton horning press are the same except for: down speed of ram, 24 ft. per min., and weight, 4,200 lb.

Bonney Extra Heavy Duty Socket Wrenches

The Bonney Forge & Tool Works, Allentown, Pa., is now manufacturing a series of extra heavy duty socket

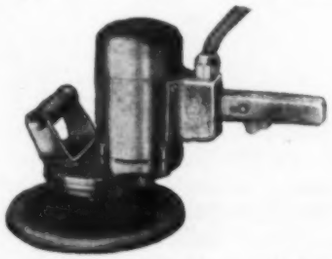


wrenches suitable for industrial work. The series consist of 14 hexagon sockets with openings from $1\frac{7}{16}$ to $2\frac{3}{4}$ in. The line also includes extensions 9 in. and 18 in. long, a 22-in. sliding bar and male and female drive heads.

The No. XH set consists of seven hexagon sockets with openings of $1\frac{7}{16}$ to $2\frac{3}{8}$ in. A 9-in. extension, an 18-in. extension, a 22-in. sliding bar are also included. All have 1-in. square drives. The set comes in a metal carrying case 23 in. long, $5\frac{1}{2}$ in. wide and $4\frac{1}{4}$ in. high. Weight, 42 lb.

Stanley Portable Electric Disk Sander

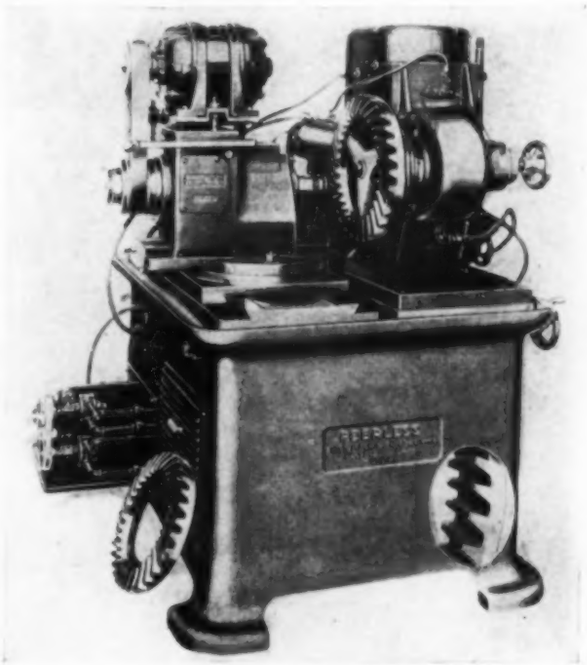
The Stanley Electric Tool Co., New Britain, Conn., has announced a portable electric disk sander for removing rust and paint, polishing lacquered surfaces and smoothing castings before and after the filler is applied. The housing of the tool is made of strong aluminum alloy. Seal-type bearings on the armature



and spindle exclude dirt, retain the lubricant and insure smooth operation. The 9-in. disk is flexible to assure smooth even work. An auxiliary handle is provided. The tool is powered by a universal motor and is made for 110, 150, 220 and 250 volts.

"Peerless" Bevel Gear Rounder

The City Machine & Tool Works, 1517 E. Third St., Dayton, Ohio, has introduced a "Peerless" machine for rounding bevel gears, as shown in the close-up in the lower right-hand corner of the accompanying illustration. This machine replaces the knife-like

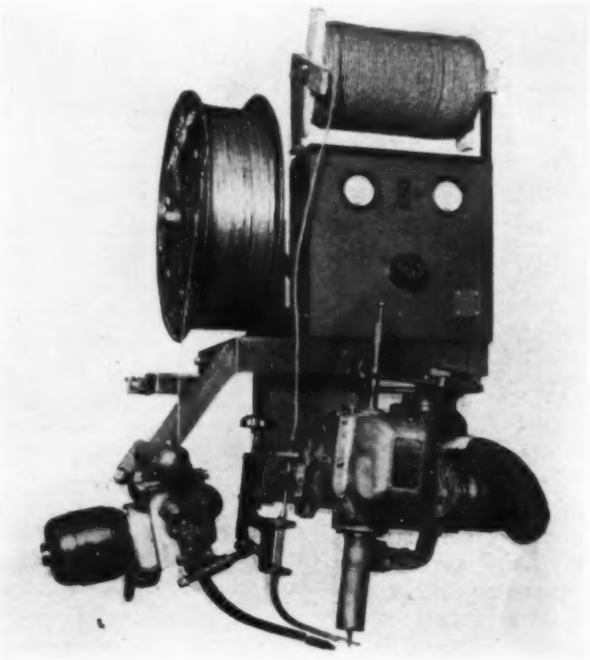


edge of the acute angle, which has a tendency to crack or chip in hardening or in service, with a smooth rounded shape that eliminates difficulties in hardening and assures satisfactory operation. The machine is completely motor-driven and has capacity for gears up to 18 in. O.D.

Lincoln Automatic Wire-Feeding Welding Head

A wire feeding head that allows automatic arc welding with the shielded arc process has been developed by the Lincoln Electric Co., Cleveland, Ohio. This head is claimed to have high-speed operation on either butt, fillet or building-up welding, the deposited metal having physical characteristics equal to or better than mild steel. The shielded arc is secured through the use of the "Electronic Tornado" welding head and a fibrous autogenizer which is fed into the arc. This autogenizer burns and forms a gas excluding the oxygen and nitrogen of the atmosphere while the metal is molten. The welding head utilizes a carbon arc around which is super-imposed a magnetic field that directs the arc stream on the line of fusion.

Automatic control of the arc is obtained thus maintaining the heat of the arc constant. Means are also provided for varying the speed of the travel of the head through a wide range. Continuous filler metal is obtained from a reel mounted on the head and fed into the arc just in front of the arc travel. Means are provided for varying the rate at which the filler metal is fed, so that the amount of metal deposited can be varied to meet the conditions demanded by the speed of the head and the type of weld being made. Since the rate at which the filler can be fed is varied independent of the speed of the head travel, only one size of filler metal is necessary for any type of work. The filler metal is usually in strip form, $\frac{3}{16}$ in. wide by $\frac{1}{16}$ in. thick. It is furnished in 70-lb. coils. The filler metal carries no current and its size is independent of the current used for welding. One size of strip can be used for any current from 75 to 500 amp. The filler strip does not pass through the arc as in metallic welding, but beneath it, and is therefore not subject to high temperatures.



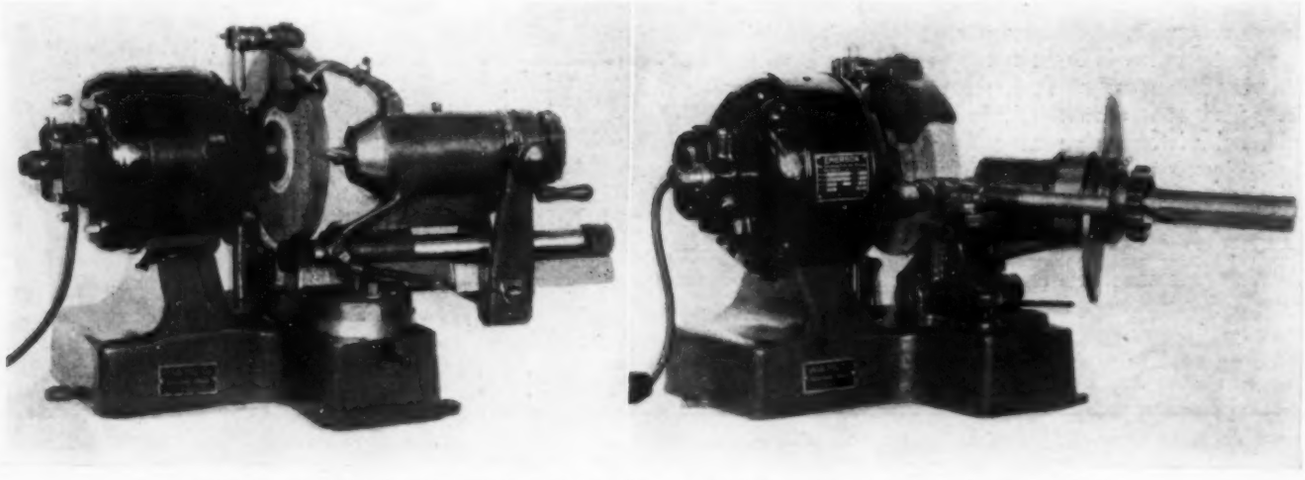
Wells No. 13-D Drill Rounder and No. 13-F Drill Sharpener

Two electric bench machines for rounding and sharpening drills have been developed by the Wells Mfg. Co., P. O. Box 613, Greenfield, Mass. The No. 13-D drill rounder is for rounding the sharp corners of the drills to increase their endurance, allow higher speed and obtain a smoother hole. The machine is equipped with a diamond for truing the emery wheel for the proper curve. The diamond is adjustable and any curve may be obtained. Drills are held in a double-end collet.

The No. 13-F sharpener is for drills from $\frac{1}{2}$ to $1\frac{1}{4}$ in. This machine has a diamond truing device attached. The grinder is portable and can be taken to the place where the drills are used. Drills are held in a double-end collet, and the machine will give correct angles and relief.

Kipp Steel Writer

The Madison-Kipp Corp., Madison, Wis., is introducing the "Kipp Steel Writer" for writing on steel or glass almost as fast as it is possible to write on paper. The device is of use for marking and remarking in tool cribs, tool rooms, laboratories and



Left—Wells No. 13-D Drill Rounder. Right—The No. 13-D Sharpener for drills from $\frac{1}{2}$ to $1\frac{1}{4}$ in.

By means of the Kipp Steel Writer marking in the tool crib can be done at the speed of writing

stock rooms. The device can be used with the Kipp Model AG or the Model BB air grinder.

A new assortment of air tool accessories is now available. It is known as Craftsmen's Choice No. 1.

• PATENTS •

MARCH 15, 1932

Metal-Working Machinery

Press. Arthur A. Byerlein, Detroit, Mich., assigned to General Machinery Corp. Patent 1,849,362.

Slideway for Machine Tools and Process of Producing Same. Harry W. Heidergott, Indianapolis, Ind., assigned to International Machine Tool Co. Patent 1,849,455.

Riveting Machine. Rudolph W. Glasner and Fredrich J. Rode, Chicago, Ill. Patent 1,849,619.

Multiple Unit Turret Type Machine Tool. William K. Millholland, Indianapolis, Ind. Patent 1,849,683.

Sheet Metal Press. Fredrich J. Rode, Chicago, Ill., assigned to Marquette Tool & Mfg. Co. Patent 1,849,691.

Metal Working Machine. Rudolph W. Glasner and Fredrich J. Rode, Chicago, Ill. Patent 1,849,711.

Metal Cutting Machine. Charles B. Gray, Millbourne, Pa. Patent 1,849,829.

Machine for Grinding Cutters. Erling Oyen, Youngstown, Ohio. Patent 1,849,849.

Centerless Grinder. Silas A. Strickland and Thomas Zimmerman, Detroit, Mich., assigned to Cincinnati Grinders, Incorporated. Patent 1,850,034.

Tools and Attachments

Adjustable Tap. Ernest A. Walker, Worcester, Mass., assigned to John Bath. Patent 1,849,160.

Broach. Donald H. West, Marlboro, Mass., assigned to The Lapointe Machine Tool Co. Patent 1,849,392.

Lathe Turning and Boring Attachment. Philipp Vetter, Oakland, Calif. Patent 1,849,512.

Chuck. Robert M. Lippard, Detroit, Mich., assigned to The Heald Machine Co. Patent 1,849,546.

Machinist's Instrument. Jacob Ash Huber, Louisville, Ohio. Patent 1,849,575.

Cushion for Sheet Metal Presses. Fredrich J. Rode, Chicago, Ill., assigned to Marquette Tool & Mfg. Co. Patent 1,849,690.

Hob and Method of Cutting for Tapered Gears. Oliver G. Simmons, Lakewood, Ohio. Patent 1,849,810.

Grinder Wheel Oscillator. Sol Einstein, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,849,868.

Thread Cutting Tap. Ernest A. Walker, Worcester, Mass., assigned to John Bath. Patent 1,849,894.

Indicating Caliper. Fred Schneider, Cleveland, Ohio. Patent 1,849,959.

Processes

Method for Controlling Motions, Particularly in the Machining of Solid Materials. Max Schenker, Schonenwerd, Switzerland. Patent 1,849,642.

Method of and Apparatus for Shaping Metallic Stock. Ezio Giacchino, Paris, France, assigned to Société Holding des Brevets et Procedes Giacchino pour l'Ebauchage Electrique, Societe Anonyme, Geneva, Switzerland. Patent 1,849,185.

Furnaces

Conveying Elements for Heat Treating Furnaces. Frank A. Fahrenwald, Chicago, Ill. Patent 1,849,287.

Electric Furnace Resistor Element. Frank A. Fahrenwald, Chicago, Ill. Patent 1,849,288.

Heat Treating Furnace. Carl I. Hayes, Providence, R. I. Patent 1,849,714.

• TRADE PUBLICATIONS •

CORE OIL. The University of Illinois, Engineering Experiment Station, Urbana, Ill., has issued Bulletin No. 235, entitled "An Investigation of the Suitability of Soy Bean Oil for Core Oil," giving a variety of conclusions, among which is that raw soy bean oil produces cores with an average tensile strength slightly higher than the average tensile strength of cores made from semi-refined or varnished soy bean oil. Copies cost 15 cents.

HEAT-RESISTING ALLOYS. The U. S. Dept. of Commerce, Bureau of Standards, has issued Research Paper No. 388 entitled "Thermal Expansion of Heat-Resisting Alloys — Nickel-Chromium, Iron-Chromium and Nickel-Chromium-Iron Alloys." The table in the summary gives a comparison of coefficients of expansion of the three groups of alloys. Copies of the bulletin can be obtained from the Superintendent of Documents, Washington, D. C., for 25 cents.

MOTORS. The Wagner Electric Corp., 6406 Plymouth Ave., St. Louis, Mo., has issued a 22-page catalog on squirrel-cage motors known as Bulletin 174. Seven types of motors are described, and other material includes application tables, speed-torque curves and complete construction details.

NITRIDING STEEL. The Electro Metallurgical Co., Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y., has issued Bulletin No. CV 1 entitled "Chrome-Vanadium Nitriding Steel." Its physical properties, depth of case, heat-treatment recommended, and advantages are listed.

RHEOSTATS. The General Electric Co., Schenectady, N. Y., has issued bulletin GEA-1084A, superseding 1084, on plate-type field rheostats for hand regulation of voltage on generator fields and for speed adjustment on constant- and adjustable-speed motors.

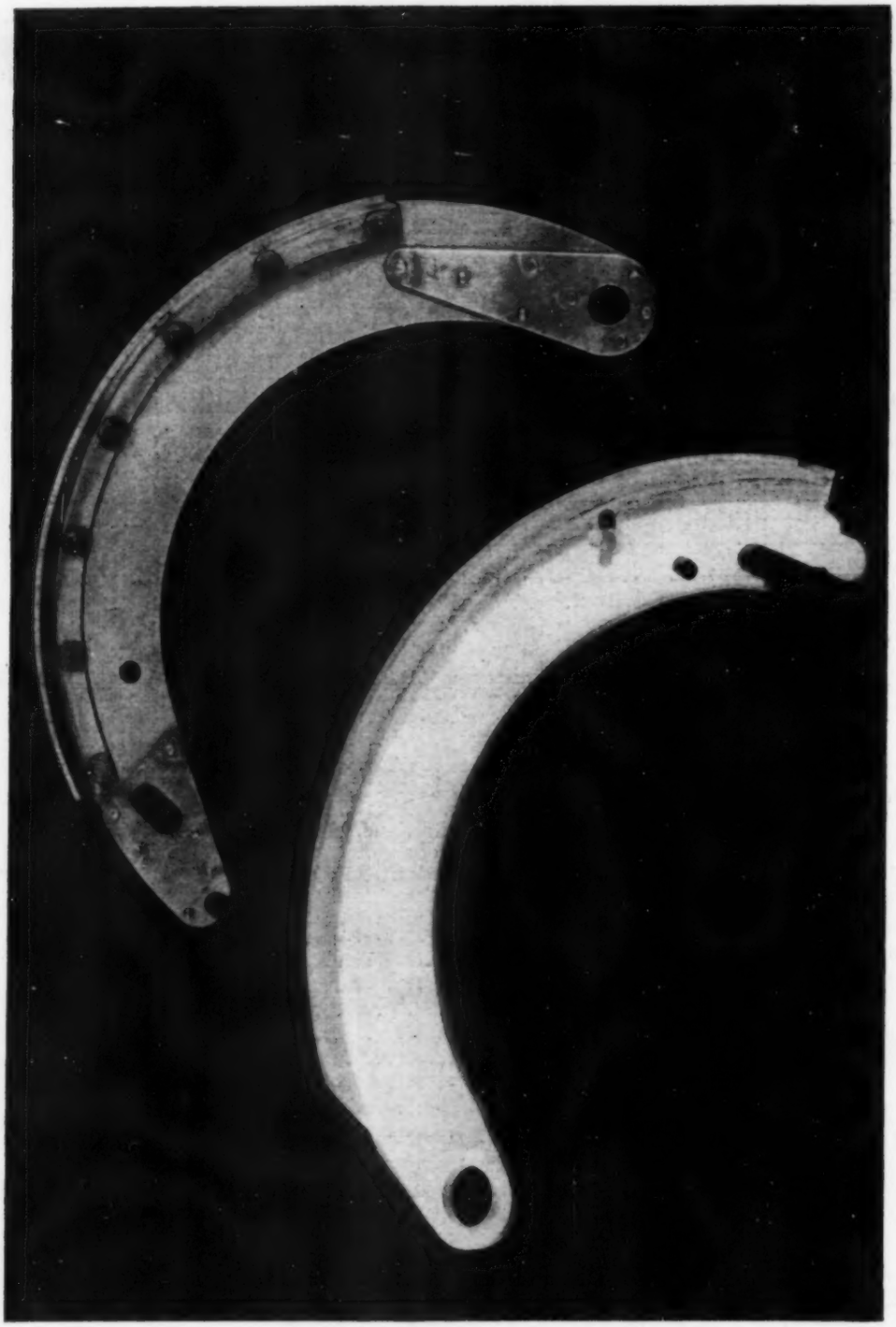
ROLLER BEARINGS. The Shafer Bearing Corporation, 621 S. Kolmar Ave., Chicago, has issued bulletin No. 501 on its line of radial-thrust roller bearings, both single and double roll. The bulletin contains complete dimensions and list prices with a speed factor table for figuring capacities for intermittent speeds. Many new sizes of bearings are listed for the first time, up to 9.4476-in. bore and 17.3210-in. outside diameter.

SPECIAL MOTOR FRAME DESIGNS. The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio, has published Bulletin No. 211 showing special frame design for its motors, inasmuch as all motors are finished with special frames, special end bells, special shafts, winding, length of leads, method of mounting or some other feature fitting it more intimately to the appliance to be driven than would be possible with a standard motor. Nine representative drawings are shown.

STEEL FITTINGS FOR WELDING. The Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill., has issued Bulletin 32-1, tabulating dimensional and list price data on its forged seamless steel fittings for welding and also forged flanges.

VENTILATING EQUIPMENT. The ILG Electric Ventilating Co., 2850 North Crawford Ave., Chicago, Ill., has issued a catalog on "ILG Propeller Fans," in which material is found on ventilating fans for offices and shops, as well as other ventilating and heating equipment.

A Single Piece in Place of Seven



ONE LARGE motor car manufacturer has been assembling internal brakeshoes by spot-welding, building them up out of seven separate steel stampings. Although the executives do not say so in so many words, it is suspected that at least two considerations moved them toward a redesign: demand for quieter brakes; demand for fewer parts in inventory. And the upshot is a one-piece brake-shoe, rolled out of T-section steel mill stock of suitable composition. Both old and new shoes are illustrated above.

Three rolls are used to secure the concave curve in one operation, two riding on the flanges and one on the web—all pressing against two rolls on the convex side. One blanking operation takes the place of seven. The result is a unit somewhat heavier than the fabricated shoe and consequently less resonant. It is understood also that production costs are decidedly lower. After the shoe is rolled, the small collared pin is staked into place.

It should be noted parenthetically that the single web roll very probably idles between the two flange rolls to allow for the relative speeds of the two arcs during the rolling operation. The light corrugations on the inside surfaces of the flanges and the absence thereof on both the fin and the convex surface would indicate that only the flange rolls are corrugated.

EDITORIALS

March 24, 1932

K. H. CONDIT • F. H. COLVIN
Editors

Wire the Commerce Department

Under the title, "Attention! Manufacturers!," we attempted to broadcast the warning (*AM*—Vol. 76, page 384a) that France was considering a discriminatory import quota on American machine tools and other machinery. France moved fast. The quota went into effect last week. The amounts assigned to the United States are so small that French agents of American manufacturers say their business in these products will be virtually stopped.

Again we urge that every manufacturer affected wire his protests to Secretary Lamont, U. S. Department of Commerce. Details of the quotas will be found in the news pages of this issue. Though relief may be improbable, it should not be considered impossible.

Indiscriminate Economy

Everyone agrees that government costs are too high for the 1932 pocketbook. Even Congress has heard enough from home to get excited about the situation. We may expect, therefore, some economy measures from Washington that will be about as intelligent as those forced on business by investment bankers—horizontal slashes that will eliminate the useful activities along with the parasitical ones.

About all we can hope to accomplish in this editorial is to call your attention to what may happen and to urge you to go over in your mind the value of any service you may have obtained from any Washington bureau. If you have never used any of them the slashes contemplated may not interest you very much. If, on the other hand, you have been accustomed to request information from such agencies as the Bureau of Foreign and Domestic Commerce, and have profited from information received, you will probably want to inform your representatives in Washington that there are some services that are really effective and that should be continued.

What Price?

Is there a buyers' conspiracy to drive prices below the cost of production? Some manufacturers seem to think so judging from the way they juggle their prices to secure an order.

But those closest to the buyers' viewpoint know that this is not the case. By far the majority of purchasers are ready and willing to pay a price that will net the supplier a fair profit. They have no wish to do a lasting injury to their industry by putting a dependable source of supply out of business. This attitude is not just theory.

The experience of one automotive parts maker confirms this. He states that although volume is low, the spread between cost and selling prices is satisfactory. He has the good sense not to attempt to secure temporary increases in volume by demoralizing prices. As a result, he is securing business where he is not the lowest bidder. Price isn't everything—even today.

Good Equipment Vital

The prime factor in heat-treating steel, according to one authority, is the selection and use of proper equipment. This, he contends, is of far greater importance than that the heat-treater should know all about the theory of steels and what happens when they are heated and quenched.

Similar statements can be made safely regarding other equipment. It matters little how much an operator knows about the theory of grinding, for example, if his machine equipment makes it impossible to turn out good work.

Equally fallacious is the idea that the operator

should know only enough to follow instructions from the planning department. It frequently happens that even a semi-skilled operator finds ways of improving on the practice outlined by the planners. But a skilled operator with poor equipment is far too likely to be outdone by the mediocre operator with the best equipment obtainable. Poor equipment is a greater handicap than many who are not directly in production work realize.

• CHIPS •

Returning from a four months' trip around the world, R. Stanley Dollar, president of the Dollar Steamship Lines, reports that business conditions are improving rapidly in almost every country visited . . . According to other advices, shipping to Shanghai is being resumed on a peace-time basis . . . China estimates that the Shanghai affair was responsible for $390,000,000 property damage, 8,080 dead and 10,000 civilians missing . . . Japan seems to be up against another internal political crisis but does not let that interfere with consolidating her gains in Manchuria and with being increasingly arrogant toward Soviet Russia . . . Relations decidedly strained . . . Great Britain continues to lead Europe in optimism and actual trade . . . France secures additional psychological compensation and reveals her true feelings toward America by means of a discriminatory import quota on machine tools and various other mechanical items . . . considers similar action on textile machinery . . . U.S.S.R. is about to deport all aliens without jobs . . . many Americans will be affected . . . Magnitogorsk, American-built "Gary of Russia," begins actual production of pig iron . . . Germany, pretty well satisfied that Hindenberg will continue as president, proves how "broke" she is by planning additional subsidies for her two greatest steamship lines.

PASSES QUARTER MILLION MARK

United Action Drive headquarters reports that 275,593 men have been given jobs during its continuing campaign against unemployment and depression . . . an increase of 55,021 over the 220,572 reported last week.

Our general sales tax continues to be mired . . . and we may have to look forward to income taxes and surtaxes on a war-time scale . . . President Hoover announces that the Reconstruction Finance Corporation, the I.C.C. and the railway executives have come to an agreement on rail financing . . . The various railroads will probably require loans totalling $300,000,000 . . . Revised Glass banking bill introduced in Senate promises stronger curb on banks, and Wall Street professes to be very much concerned . . . Might be about time for Wall Street and the Congress to ponder the fact that of 142 new industries established in Canada since August 1930, 131 are from the United States . . . Our tariff policy might conceivably have something to do with it all . . . might also explain Department of Commerce warning of a further trend toward retaliatory tariffs . . . Ford continues to hold up the procession for another week and great big American business men continue to let him . . . But some may not have heard that credit is available at banks and that prices are so far below prewar as to be ridiculous and dangerous.

Rumored, denied, discussed and rediscussed that Willys will reassume active control of Willys Overland . . . February orders of members of Foundry Equipment Manufacturers Association show gratifying upturn . . . Metal-working activity up in general, as indicated by electrical energy consumption reports . . . Armstrong Cork Company will buy back 24,000 shares of capital stock sold to employees . . . will rescue them from the banks . . . National Air Transport 1931 profits, $490,639, run above 1930, $431,175 . . . United Air Lines enjoys 34 per cent increase in passengers during February.

Westinghouse Electric & Mfg. secures one of largest commercial lighting fixture orders ever placed . . . Marshall Field & Company will use 5,700 units in its new building . . . Rubber consumption by American manufacturers in February jumped 7.3 per cent over January . . . increase is contrary to a normal seasonal decline of 3.5 per cent . . . Nash automobile orders are up 50.9 per cent for first 15 days of this month . . . unfilled retail delivery orders have increased 418 per cent since February 27 . . . February shipments of all Chrysler divisions were 36 per cent ahead of January . . . Leonard division of Kelvinator reports February shipments 56 per cent above January and 129 per cent ahead of last year . . . Norge sales are running 20 per cent ahead of 1931 . . . Contract for Radio City heat control system goes to C. A. Dunham Company.

· REGIONAL · REPORTS ·

NEW YORK—Bright prospects, few inquiries, fewer orders—these tell the local tool market story. Each dealer had a few small orders, a $400 machine was exceptional, but one or two had a better week than the previous. Size of current inquiries is indicated by that of the Navy for a 4-jaw chuck.

NEW ENGLAND—Builders patiently await buying revival by automotive industry. Early orders from this source about depleted. Buying interest of general industry practically at standstill. During the week, Navy Department closed bids on new list of tools for eastern Navy yards. Electrical refrigerator manufacturer and automobile accessory manufacturers took a few tools.

PHILADELPHIA—Improvement noted at three separate points. Manufacturers of bearings report orders from higher-priced automobile manufacturers and from manufacturers of electrical accessories. Continued volume expected for at least sixty days. Manufacturers of leather belting and other shop equipment report improvement since first of year with orders from southern states. Producers of measuring instruments see better tone in last two weeks. Producers and manufacturers of machinery and machine tools note no improvement, hazard no guesses.

CLEVELAND—Machine tool business bumping along bottom at end of discouraging first quarter. Promises of sales from local auto accessory manufacturers when Ford releases orders. Some grumbling about prices.

CINCINNATI—Manufacturers and selling agents have small volume of orders. Inquiries remain at about previous level, most from general machinists and miscellaneous users who hope to get work that will require them.

CHICAGO—Past week one of dullest, but at least two dealers will close March far better off than during first two months. Bids closed for license-plate machines for Illinois Penitentiary—Henry & Wright dieing machines, American Electric Furnace drying ovens. Westinghouse Electric Elevator bought some used, some new tools. Effect felt of delay in placing Ford part orders. No new business at Rockford, though some old Ford orders keep several shops busy.

WEEK succeeds anxious week as tool builders and dealers await some sign of betterment in general business . . . As alibis and cure-alls wear thin, one metal - working company after another faces facts, forgets 1928 and 1929, goes to work on today's basis . . . When this movement filters through industry, tools will again be in demand . . . Meanwhile a few sales a week, a few more inquiries, many apparently bright prospects fill builders' and dealers' days . . . Government inquiries are fewer in number, though the Navy closed bids on a new list.

APPARENTLY, everyone awaits Ford production in the hope that it will resurrect business overnight . . . Ford plods on, telling only what is to his advantage, buying what tools he needs for his production lines, taking delivery April 1 . . . New England sold a tool or two to electrical refrigerator and automobile accessory makers; Cincinnati expects sales to accessory makers shortly . . . Southern orders all small, though used tools are going better there now . . . Detroit quiet, watching Ford with baited breath, hoping . . . Chicago had a dull week, but March has been fairly good . . . Philadelphia sees some general improvement.

MILWAUKEE—Scattering of single unit orders from diversified sources makes up present business of machine tool manufacturers and selling agents here. March will probably show trifle better volume than did February, conceded bottom in machine tool business locally. Inquiries also diversified, but appear closer to closing than for some time past. With exception of some special equipment for Ford, automotive trade dormant. Future prospects depend entirely upon Ford announcement. Government aircraft and navy requirements bringing small amount of new business. Prospects in commercial aircraft with release of orders by one manufacturer for several units. General machinists and miscellaneous users make up bulk of small amount of business being placed. Used tool buyers apparently holding off for still lower prices which may follow more stagnant market.

DETROIT—Market almost dormant for many weeks while auto industry frankly waits for next Ford move. Ford still purchasing and installing machinery for production line. Practically no other concerns make either purchases or inquiries. Offer little information on future plans. Some equipment dealers believe skies are brightening. This opinion not based on anything tangible. But certain intangibles indicate year 1932 will bring substantial improvement. One large manufacturer of low-priced cars known to be experimenting with radically new model which, if produced, may require good deal of equipment. Others wait for market to change.

MATERIAL TRENDS AND PRICES

The export organization of the copper industry stated March 11 that following recent conferences further curtailment, to 20 per cent of capacity, is expected to be achieved. This should reduce world output to some 60,000 tons per month. Prices of pig lead were dropped from 3.25c. per pound in New York to 3.15c., and in St. Louis from 3.05c. to 3c. Tin has been fairly active through purchases for tin plate. Iron and steel continue quiet.

(All prices as of Mar. 18, 1932)

IRON AND STEEL

Pig Iron —	Current	Mo. Ago	Yr. Ago
Birmingham, No. 2, Fdry., per gross ton	$11.00	$10@$11	$14.00
Buffalo, No. 2, Fdry., per gross ton	14@ 15	14@15	17.50
Heavy Melting Steel Scrap — Pittsburgh consuming point, No. 1, per gross ton	10.00	10.00	12.75
Furnace Coke — Connellsville, per net ton	2.25	2.25	2.50
Foundry Coke — Connellsville, per net ton	3.25	3.25	3.25
Steel Shapes — Pittsburgh, base, per 100 lb	1.50	1.50	1.65

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Iron Machinery Castings — Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight, 275 lb.

Chicago	4.62½	Cleveland	4.50
Cincinnati	4.35	Detroit	4.00
New York	4.75		

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Steel Sheets — Prices in cents per lb., del. from warehouse stock (except at Pittsburgh) in lots of 401 to 999 lb., ordered and released for shipment at one time:

	Pitts. Mill	Chicago	Cleveland	New York
Hot-rolled, No. 10	1.85	3.20	3.00	3.00
Hot-rolled, No. 24*	2.40	3.55	3.25	3.50
Galvanized, No. 24	2.90	4.10	3.75	4.00

*Annealed

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Seamless Steel Tubing — Cold-drawn mechanical tubing, round, .10 to .30 carbon, in lots of less than 100 ft. or 100 lb., net, at N. Y. warehouse:

— Thickness —		Outside Dia. in Inches					
of Wall		½	⅝	¾	⅞	1	1⅛	1¼
Inches	B.w.g.	Price per Foot						
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23

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Shapes, Plates, Bars, Etc. — Warehouse base prices in cents per lb., del. in lots of 401 to 999 lb., ordered and released for shipment at one time:

	New York	Cleveland	Chicago
Bands	3.30	3.00	2.95
Bars, soft steel	3.00	2.75	2.75
Cold fin., flat or square	3.80	3.60	3.60
Cold fin., round or hexagon	3.30	3.10	3.10
Cold rolled strips	4.95	5.95	5.50
Floor plates	4.75	5.00	5.00
Hoops	3.65	3.55	3.50
Rivets	4.00	3.30	4.00
Shapes	3.00	2.95	3.00
Spring steel	4.00	4.00	4.00
Tank plates	3.00	2.95	3.00

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Stainless Steel — Hot-rolled bars, base, Pittsburgh, 0.12 per cent carbon, cents per lb.:

Chromium		Chromium	
15% and under	19.00	18 to 23%	23.00
15 to 18%	20.50	23 to 30%	28.00

Bolts and Nuts — Discount from list, f.o.b. mills, Birmingham, Chicago, Cleveland and Pittsburgh, on bolts (except stove) nuts, and lag screws, mill lots 75%

NON-FERROUS METALS

Prices following are in cents per lb. for mill shipments in carlots:	
Aluminum ingots 99%, N. Y.	23.30
Copper, electrolytic, Conn	6.00
Copper wire, base, Chicago and Cleveland	8.62½
Copper wire, base, N. Y.	8.50
Lead, pigs, E. St. Louis	3.00
Tin, Straits, pigs, spot, N. Y.	21.80
Zinc, slabs, E. St. Louis	2.80
Prices following are in cents per lb., base, N. Y., Chi. and Cleve.:	
Brass rods, high	10.25
Brass sheets, high	12.50
Brass tubing, high	15.75
Copper, drawn round	12.87½
Copper sheets	15.37½
Copper tubing	14.87½
Prices following are in cents per lb., del. from N. Y. warehouse:	
Babbitt, anti-friction, general service manganese	26.00
Babbitt, com'l, intermediate grade master, copperharden	32.00
Babbitt, genuine, highest grade	42.00
Solder, bar, com. 40:60	15.00
Prices following are in cents per lb., base, Huntington, W. Va.:	
Monel metal rods, hot rolled	35.00
Monel metal sheets, full finished	42.00
Monel metal tubing, seamless	65.00
Nickel rods, hot rolled	45.00
Nickel sheets, full finished	52.00
Nickel tubing, seamless	75.00

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Scrap Non-Ferrous Metals — Dealers' purchasing prices in cents per lb., f.o.b. cars:

	New York	Cleveland	Chicago
Heavy yellow brass	2.00	2.00	1.50
Light brass	1.50	1.25	1.25
No. 1 rod-brass turnings	2.25	2.25	1.50
Heavy copper	4.00	3.25	2.75
Light copper	3.25	2.75	2.25

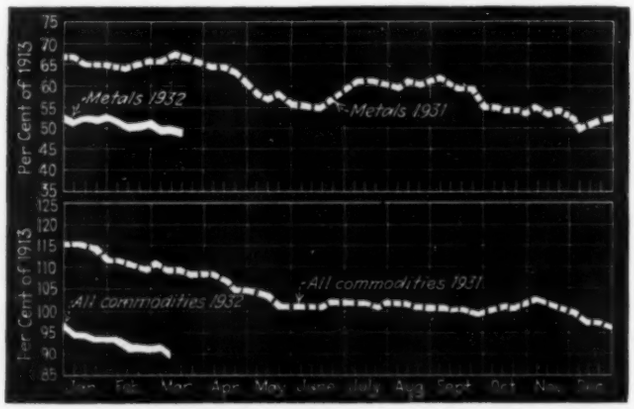
SHOP SUPPLIES

(Prices at warehouse)	New York	Cleveland	Chicago
Abrasive disks, aluminum oxide No. 50 grain, cloth, 6-in. dia., X weight, per 100	$4.37	$4.59	$4.59
Belting, leather, heavy	40–5%	40–5%	40–5%
Belting, rubber, trans., Grade 1	60–10–10%	60–10%	60%

Lumber — Per M ft., b.m., 12–16 ft. lengths, delivered, N. Y.:

Crating — Southern pine:
1x4-in. ..... $24.00 1x6-in. $27.00

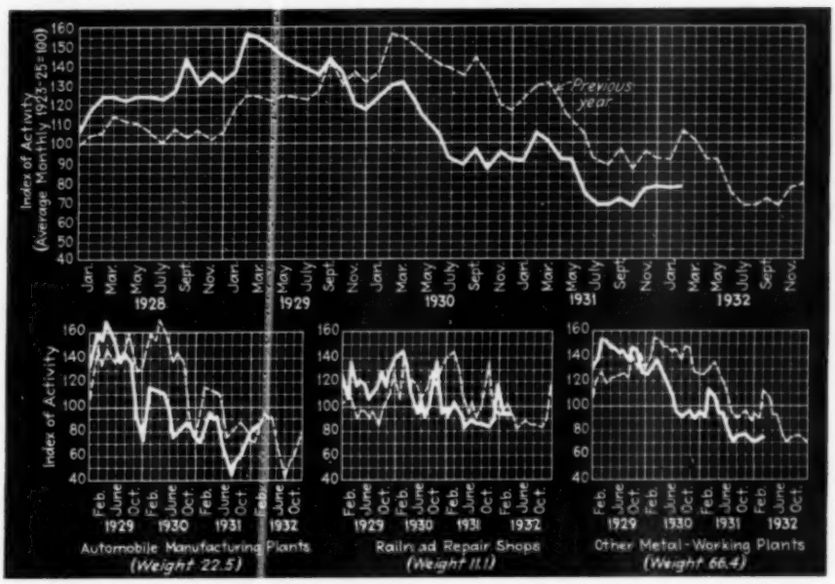
Skids — Spruce:
2x4-in. .$35.00 3x4-in. .$35.00 4x6-in. .$37.00 6x6-in. .$50.00


Per Cent of 1913
Metals 1932
Metals 1931
All commodities 1931
All commodities 1932
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Price Movements Week by Week

Average Price of Raw Metals: Pig Iron, Billet Steel, Copper, Tin, Lead, Zinc—American Machinist
Seventy-Four Commodities Index—The Annalist

Metal-Working Production Indexes For February Show Slight Upturn



METAL-WORKING activity in general increased slightly during February, according to reports on consumption of electrical energy for power purposes. This follows a more or less static January, succeeding two months of upturn in activity. The final February figure was 79.2, as compared with 77.6 in January, 77.8 in December, 75.6 in November, 69.4 in October, 71.2 in September, and 68 in August and July. These figures are all adjusted for 26 working days, as are subsequent ones.

The automobile shop index moved up to 85.3 from 83.6 in January and 78.1 in December. In previous months it was: 65.5 in November, 1931, 67.4 in October, 53.7 in September, 43.6 in August, and 55.9 in July. The railroad repair shop index rose slightly from 91.5 in January to 92.6 in February after a 20 point drop from 118 in December. It was 94.9 in November, 1931, 84.5 in October, and 84.0 in September, 85.5 in August, and 84.3 in July. Ferrous and non-ferrous metal-working plants outside these two groups had a February index of 74.8, up two points from the 72.7 of January, and two points more from the 70.9 of December. In November it was 76; October, 71; September, 75; August, 73.3; and July, 69.3.

When the figures are adjusted for seasonal variations, slight revisions occur. The railroad repair shop index drops to 81.7, and the general metal-working index drops to 67, while the automobile shop index declines to 81.8. This gives a total seasonally adjusted figure of 72, down seven points from the 79.2 of the unadjusted index. Railroad repair shop seasonally adjusted indexes were, in previous months: January, 86.5; December, 116; November, 90.1; October, 85.5; September, 87; August, 96.2; and July, 92. Similar automobile shop indexes were January, 98; December, 114.2; November, 78.1; October, 55.4; September, 52; August, 45.3; and July, 56.3. Similar figures for other metal-working plants are: January, 68.7; December, 73.2; November, 78.1; October, 72.5; September, 76.0; August, 79.3; and July, 73.5. Figures for the entire group were January, 77.3; December, 87.2; November, 79.4; October, 70.1; September, 79.1; August, 73.5; and July, 71.7.

French Quota Hits Our Machine Tools

(By Cable)

Despite formal protests by the American Chamber of Commerce of Paris and the American Embassy regarding alleged discrimination of the French Government against American manufacturers, a new quota limiting severely the importation of machine tools made in the United States was established March 17 by official decree. Preliminary consultations were held only with German manufacturers. According to the Chamber, Germany is particularly favored by the quotas, since 66 per cent of the combined total of all articles in the quota decree goes to Germany in addition to the unlimited quantities which she may send in as reparations. Furthermore, the central German association of machine tool builders has the power to issue licenses to German manufacturers of machine tools which will permit them to send their products directly to France. No other country has this privilege.

The American Chamber of Commerce has asked the French Ministry of Commerce not only to consult with importers of American machine tools before putting the decree into effect but also to eliminate from the quota American machine tools which are not manufactured in France and those which sell for a much higher price than the similar French competitive machine tools.

France to Ignore Protests

Said the Chamber: "The French Government has indicated clearly that it does not intend to take into the least consideration or consult with the importers of American products before the establishment of quotas.

"The machine tool quota is one of the most devastating against American commerce and involves the greatest loss in dollars to American trade of all the quotas put into effect in recent months."

Machine tool importers pointed out that in the case of one item alone—drop hammers—the quota for all countries except Britain and Germany was forty-two tons for the four months from March 1 to June 30. Some hammers of this type made in the United States weigh forty-two tons each and the quotas include the packing as well as the machines.

Other machine tools manufactured in the United States which come under the new quota are printing presses, machinery drills, measuring instruments, pneumatic hammers, brass, nickel and chrome spare parts and wrenches. The amounts assigned to the United States are so small that agents of American manufacturers say their business in these products in France will be virtually stopped.

1931 Exports Two Million

While estimating the value of machine tool exports to France at about $2,000,000 for 1931, Department of Commerce experts were unable to determine exactly the value of the exports involved. It was explained that this was due to the differences in tariff classifications under the American and French systems and to the fact that under the latter, numerous items are classed as machine tools which are not so considered in the American tariff.

An incomplete list prepared at the department showed the value of exports from the United States to France in recent years of commodities classed in this country as machine tools, but which did not include all articles affected by the new quota. This list showed 1931 exports of $1,628,138, compared with $3,293,660 in 1930 and $6,453,388 in 1929.

List of Quotas Issued

The Department of Commerce issued today the following list of a majority of American machine tools and articles af-

fected by the French import quota on machine tools; with the value of such exports to France in 1929 and 1931:

Class	1929	1931
Engine lathes	$406,436	$42,361
Turret lathes	190,827	48,917
Other lathes	101,295	8,225
Vertical boring mills and chucking machines	82,399	14,700
Thread-cutting and auto screw machines	268,181	49,118
Knee and column type milling machines	299,135	44,255
Other milling machines	307,207	61,673
Gear cutters	505,718	81,933
Vertical drilling machines	137,933	1,254
Radial drilling machines	30,846	.....
Other drilling machines	97,193	33,108
Planers and shapers	69,100	40,459
Surface grinding machines	78,878	8,083
External cylindrical grinding machines	527,959	101,429
Internal grinding machines	206,555	41,638
Tool cutter and universal grinding machines	100,750	91,646
Other metal grinding machines	182,200	90,738
Sheet and plate metal-working	942,662	48,286
Forgings	328,197	105,592
Rolling mills	95,164	17,562
Foundry	70,745	11,438
Other power-driven metal-working machinery and parts	575,711	274,168
Portable pneumatic tools	174,085	118,108
Other portable and hand or foot-operated metal-working machines and parts	83,419	55,887
Chucks	40,699	18,297
Drills and reamers	104,757	55,525
Pipe and die stocks, etc	46,033	57,323
Other thread-cutting die stocks &c	115,258	35,918
Other metal-working machine tools	197,896	64,103
Saw mill machinery	5,020	2,279
Planers, jointers, etc	14,402	.....
Other wood working machinery	66,726	3,919
Veneer	.....	196
Total	$6,453,388	$1,628,138

The department's information is that out of the total quota of machine tools permitted to enter France under the new decree about 50 per cent is allotted to Germany. German deliveries for account of reparations in kind are not included in the quota.

We asked our Paris correspondent to prepare a report on possibilities of the quota on machine tool imports. His report follows.

FRENCH industrial revival depends upon many things, not the least being the pegging of the new budget to meet an abnormal demand of 10 billion francs already looming unexpectedly large. Taxation of industrial and trade activities, however, appears to have reached its limit. Most important industrial enterprises are lethargic, while looked-for improvement has in no single instance materialized. Moreover, official government labor statistics now announce publicly that more than a quarter of a million workers are benefiting from what in France corresponds to the dole.

The really active branch of metal transforming is the fast developing agricultural machinery industry. If not actually allied, the various units work more or less in concert and from small scattered shops have expanded into well-equipped establishments, some of considerable proportions. The industry as a whole employs 350,000 workers.

An outstanding threat that what will virtually amount to a French embargo on American machine tools is rife with dire possibilities. The dominant note of French foreign trading policy in the future is not an increase in the tariff *per se* but the application of a quota and contingent system to imports which, according to the rigidity, can be made to serve even more effectively as a brake. The plan makes no distinction between production or consumer goods; electric appliances and machine tools are all envisaged.

France having acquired the *quota* and *contingent* habit as a means of whipping the import devil around the tariff bush is now suggesting its application to limiting imports of American machine tools on a basis of computation which may give precedence to like imports from Germany and Great Britain. Much depends upon the various classifications embraced by the term "machinery and machine tools." In any case "cutting down the import of foreign products to the minimum," now to be applied to machine tools, as it has been applied to radio apparatus, points out a back seat for U. S. makers, while inviting Germany and Great Britain to move up toward the front.

Quotas will be arrived at by taking the average *bulk* of imports from various countries during the past three years. Danger lies in the French method of applying duties in the first instance—specific as to weight. Secondly, the heavier, crude imports from Germany, for instance, will help bulk those imports large, and with the quota based on bulk, not value, will prove doubly detrimental to the American product.

Franco-German points of commercial contact have become less genial as the result of frozen credits. The Chamber of Commerce for French Export Trade has recommended its members to demand cash with order with respect to all future transactions and no longer accept German bank credits.

German exports to France, in spite of the reduction of reparations in kind, remained in 1931 at 94 per cent of the figure of 1929, while French exports to Germany fell to 58 per cent. The balance of German trade against France during these two years has increased 1,500,000,000 francs.

The French mechanical trades saw their production during the first half of 1931 stand at 91, as compared with 100 in 1929, while Germany's fell to 60, Great Britain's to 82 and Poland's to 58, according to the League of Nations survey of world depression factors. The index was the lowest recorded for Germany and Great Britain since 1927 but was higher for France than in 1928. Poland's index was considered despressingly low.

The general trade situation in France has been greatly affected by the falling off in the demands for expensive consumer goods—those usually paid for out of savings, automobiles, labor-saving household equipment, etc.

Production did not greatly decline before the middle of 1931, but henceforth, either dropped suddenly or stocks were allowed to accumulate until the bell rang automatically and a halt was called. This was none too soon; France heeded the admonition long after Germany and Great Britain.

For the above reason France is bound to enter into a long period of readjustment, itself to be greatly advanced or retarded by the result of the just convened Reparations Conference (France, Great Britain, Italy, Belgium and Japan) for June next. Whatever the new reparations settlement may be, the question of debts to America will then have to be discussed.

THE BUSINESS WEEK

March 23, 1932

A light frost fell upon financial markets about the Ides of March, chilling the more cheerful atmosphere of recent weeks . . . Foreign influences were the chief factors, although the uncertain effects of the Kreuger & Toll affair were offset by the favorable outcome of the German elections . . . Fears about balancing the federal budget in face of falling income tax returns and revolt on the sales tax feature of the new revenue bill were weakening factors in the bond market . . . The surprising steadiness in the broad averages of stock prices since the middle of December is a significant symptom of increasing resistance to discouraging news . . . Although some slight slow improvement in the banking position is perceptible, especially in steadiness of country bank deposits, the pressure toward expansion under Federal Reserve open-market policies is still disappointingly feeble . . . The attitude of member banks toward cooperation with administration efforts for credit expansion continues uncompromisingly skeptical about the possibility of speeding recovery . . . In consequence, commodity prices continue weak and business activity still shows almost no sign of response to spring stimuli, although it seems to grow no worse . . . Steel production has relapsed slightly under postponement of Ford production plans, and building prospects for March are less encouraging than the February figures indicated, but merchandise carloadings and electric power production show some relative improvement recently . . . Britain is still the bright spot in the European picture.

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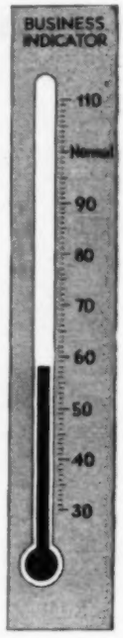


Just How Quickly Can Machine Shops Make Guns?

FRANCIS M. MANSFIELD
Paris, France

HOW readily the average machine shop may be turned into a gun or ammunition factory is occupying one or another of the committees of the Disarmament Conference called by the League of Nations to almost the same extent as the discussions as to what constitutes a civilian airplane and what is needed only to be added thereto to make it an engine of war.

The scope of investigations conceived by the organizers of the Disarmament Conference is wide. There are apparently no mechanical or production experts on the rosters of the delegations of the 60-odd governments represented in this greatest of international conferences the world has ever known. It may be that among the 70-odd Japanese delegates and experts that there are such, perhaps others are camouflaged as "advisers" in the German delegation or the British. Close contact with the American delegation has failed to discover any such talents.

However, the private manufacture of small and big guns, ammunition and explosives is still a factor in world trade and probably a profitable one for many of Europe's heavy metallurgical and metal transforming industries with good back-logs of orders—Schneiders, Krupps, Vickers, Arsaldo and Skoda are by no means shut down.

If we are to believe the facts and figures of the League of Nations experts who have compiled the documentary aids for the Disarmament Conference statistics supplied by the various governments do not make sufficient distinction between "arms of war and arms of defence," and too often include gun-carriages and tanks as wheeled vehicles and automobiles.

According to a voluminous League document of nearly 500 pages, 39 countries have exported arms and ammunition during the past five years, the outstanding manufacturing countries (the others presumably being middlemen) being Germany, the United States, France, Great Britain, Italy, Poland, Spain, Czechoslovakia and Sweden. At the same time 59 countries were importers—of which the part of China has been as high as 12 per cent of the entire world exports, that of Japan, up to 1931, not exceeding 3.7 per cent.

Great Britain is the largest exporter of arms and ammunition—33.8 per cent ($21,727,400). The United States is second with 16.7 per cent ($10,734,500). France is third with a percentage of 14.6 ($9,374,500). Poland is the smallest exporter, 0.1 per cent, the equivalent of $65,600.

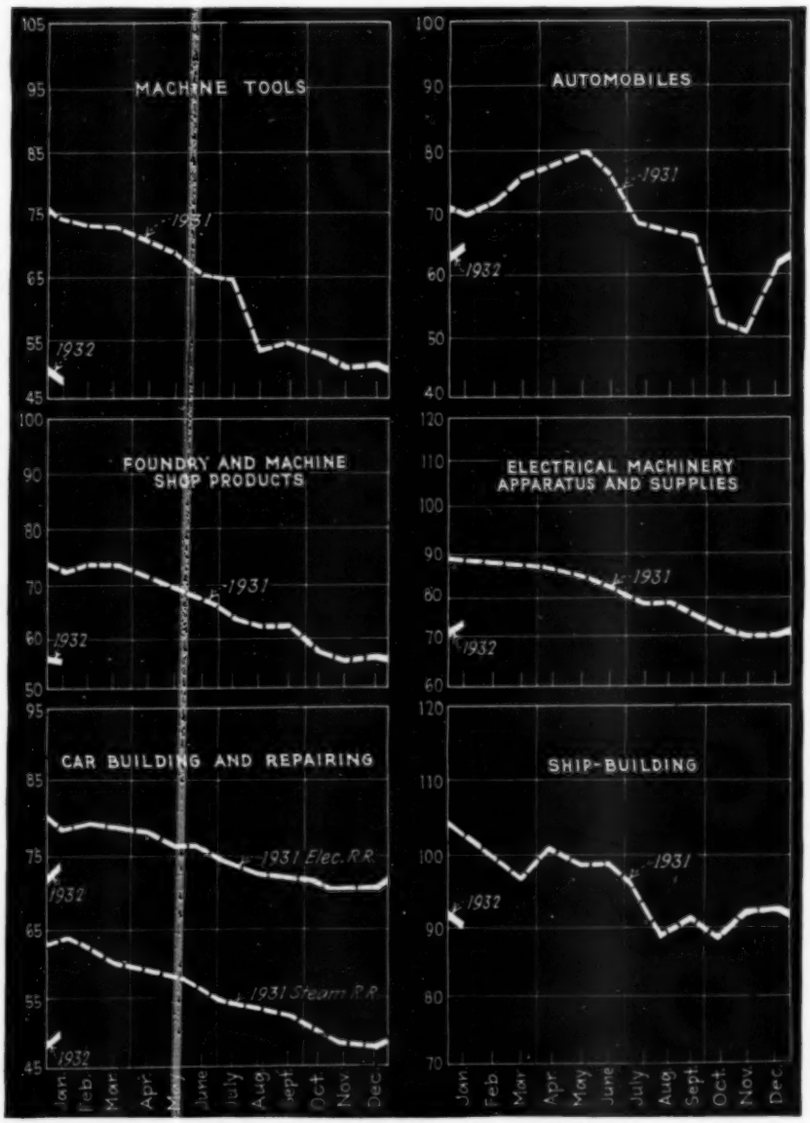
China since 1924 has bought annually about half a million dollars worth of what by a liberal interpretation are classed as "sporting arms." The three largest exporters of sporting arms are Germany (normally $7,500,000 per annum), Belgium ($3,000,000), and Great Britain ($3,500,000). It is curious to note, and quite inexplicable except by blinking the eye and stultifying one's logic, that of nearly 80 million dollars worth of world exports of arms and ammunition only $50,000,000 in value got to their destination, the others having been "diverted" *en route*— this being the only conclusion possible.

Germany to date has put up to the conference the strongest plea against the manufacture of and traffic in (importing and exporting) arms and munitions of war. It argued that they should be strictly prohibited except that States who manufacturing none themselves might be allowed to import the quantities necessary for their needs.

Further, that all private arms and ammunition factories—operations of which should be given full publicity—should have their output limited to quantities authorized by the government, including such quantities as *bona fide* export orders may call for.

All this is an outgrowth of the abortive convention of St. Germain in 1919, ratified only by China, Greece, Guatemala, Haiti, Peru and Siam. In May 1925 another conference was held at Geneva which sought to limit the export of arms by government license but this, as yet, has not received the sufficient number of ratifications (fourteen) to bring it into force. Neither the United States, Germany, Italy, Japan, Belgium, Canada or Switzerland have ratified.

The United States government in reply to an inquiry from the League of Nations, under which the agreement



TREND OF EMPLOYMENT IN METAL-WORKING INDUSTRIES Monthly average for 1926 = 100. Data supplied by the Bureau of Labor Statistics

was brought into being, stated simply that "upon the adjournment of the last congress the United States Senate had not yet approved ratification." Italy replied that she did not propose to ratify before the entry into force of the hoped-for disarmament agreement. Canada made a proviso for ratification first, or concurrently, by the United States, Germany, Japan and Italy. Germany stated that in view of possible modifications in the convention, and in spite of its desire for a speedy solution, it postpones provisionally its ratification (as does Italy), awaiting the outcome of the general disarmament conference.

Summing up, we have a situation which has naturally evolved itself into an economic one. The League's Financial Section has no available figures showing the capital interested in the manufacture of implements of war, and its satellite, the International Labor Office, has no statistics indicating the number of workers directly employed in such industries nor the amount of wages involved. In addition there is of course the loss to raw material consumption, the machinery trades and in general the accessary consumption goods.

No one at Geneva pretends that the Peace of the World is to be crucified on the Mount of Industry but it is evident that the project of disarmament, even partial, is developing new phases from day to day, and this quite apart from the security of nations whose slogan is, in Europe at least, and ever has been "in time of peace prepare for war."

Soviet Russia's New 5-Year Plan Aims

EMPHASIS is placed on the production of consumption goods in the new 5-year plan just announced by the Soviet authorities. Another significant feature of the new plan is the omission of any reference to plans for the development of foreign trade.

At the end of the new 5-year period the output of the machine building industry is scheduled to be 3.5 times that of 1932. More power plants are to be built to permit the "widest application of electric power in industry and transport and the gradual introduction of electrical energy for agriculture."

In 1932 Russia is expected to produce 17 billion kilowatt hours of electrical energy. Under the plan this is to be increased to 100 billion kilowatt hours in 1937. Under the new 5-year plan Russian coal production at the end of the period is to be 250 million tons. The 1932 production is estimated at 90 million tons. Oil production is to be increased three times over 1932.

The 1937 output of pig iron is fixed at 32 million tons. It provides for a complete technical reorganization of the iron and steel industry. By using selective flotation and improved methods of smelting the plan provides for Russia to be self-sufficient at the end of the 5-year period in copper, lead, zinc and aluminum. Rare metal production is to be expanded.

Russia's chemical industry, the report says, has constantly been lagging behind the other major activities. Particular attention is to be paid to this industry in the new 5-year plan, with the production of fertilizers as the principal objective.

The new plan provides for 19,000 additional miles of steam railroad line. Rolling stock is to be built up and large use made of Diesel locomotives. Certain lines are to be electrified. An automatic signal system is to be installed. River and harbor work is to be pushed. The highway system is to be expanded and additional attention is to be given air transportation.

X-Ray Studied By A.S.T.M. Group

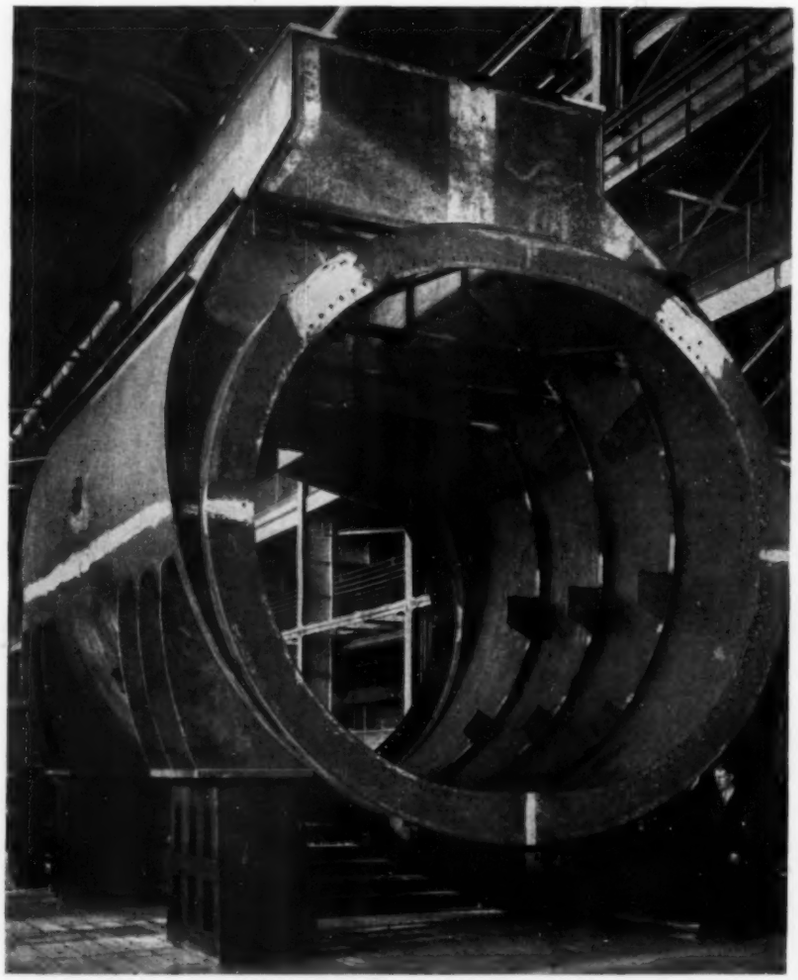
A subcommittee of A.S.T.M. Committee E-4 on Metallography is actively engaged in investigative work in the X-ray and gamma ray testing field.

Gear Association Moves Its Offices

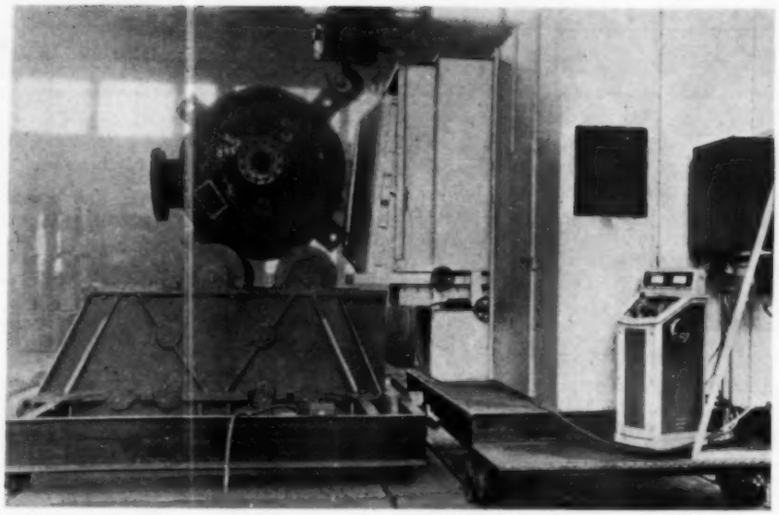
American Gear Manufacturers' Association has moved from 3608 Euclid Ave., Cleveland, Ohio, to Ninth-Vincent Bldg., Cleveland.

Vocational Guidance Is Camp Subject

Several colleges and some of the major engineering and industrial organizations are represented in an experiment in vocational or collegiate guidance for boys which will be made at the Stevens Institute Engineering Camp in northern New Jersey for two weeks this summer, August 13 to 27. One of the more important decisions of a boy's life, PRES. HARVEY N. DAVIS, of the Institute, said, is his choice of a college, not so much his choice of a particular college as the type of college for which he is best fitted and which may lead him to a career where he will find satisfaction.



A 65,000-sq.ft. condenser just completed at South Philadelphia Works, Westinghouse Electric & Mfg. Co., to serve a 75,000-kw. single-cylinder condensing unit for Public Service Gas & Electric at Kearny, N. J. It was fabricated in two parts so that it could be shipped, and even then went most of the way by barge. It is 34 ft. 4¼ in. long, 30 ft. 7¾ in. high, 22½ ft. wide



Designed primarily for routine inspection of welded seams in pressure vessels, according to the A.S.M.E. Boiler Code, this X-ray installation at Sun Shipbuilding & Drydock Co. can be used with equal facility for inspecting castings and other objects. Vessels are supported on two sets of adjustable gear-driven rolls, each on a movable truck. X-ray tube and generator are mounted in a movable car also, the tube within a lead-lined box mounted on trunnions for tilting. A dark room is also provided in this complete installation by St. John X-ray Service Corp.

Patent Law Changes May Pass This Congress

FUNDAMENTAL changes of far-reaching importance are being proposed to the Patents Committee of the House of Representatives which has been holding a series of hearings under plans formulated by its new chairman, Rep. William I. Sirovich of New York. Changes which have been proposed fall in three general classes: Those which relate to the securing of patents, those which would affect patent litigation in the courts, and those which have to do with the ownership of that intellectual property which results from invention. Recommendations and suggestions of those who have testified before the committee are summarized in the following paragraphs.

Patent office procedure should be expedited, and several specific proposals to this end have been made:

1. Provisions that a classification division be established adequately manned to furnish reliable and complete records for use within the patent office and for consultation of attorneys and patent applicants outside the office. A bill is now being drafted providing that about 30 experienced examiners shall be assigned to such a division, and providing funds for the enlargement. This measure is likely to be passed immediately by Congress, because the patent office is almost self-sustaining, as the fees charged nearly equal the cost of operation.

2. A highly controversial provision intended to prevent applications for patents from being unduly delayed in the patent office has been proposed by the American Bar Association. As presently presented, the bill gives the Commissioner of Patents authority at the end of a three-year period to require a patent applicant at once to put his case in such shape that final action by the office may be taken within 30 or 90 days, resulting in either rejection or granting of the claims or the advancing of the patent to the stage of appeal.

3. Because of the controversy over measures proposing the limitation of time in the patent office before issue of patents, an alternative idea has been proposed. Under this newer scheme the life of a patent would terminate either 17 years from the date of issue or 20 years from the date of filing, whichever date was the earlier. This idea will definitely be introduced as a bill and may receive congressional action during the present session.

4. It is proposed to empower the individual or company to whom a patent application has been assigned the right to file without aid of the inventor either a divisional, continuation, renewal, or reissue application. By this means it is hoped that an assignee will secure full control and ownership of the invention in a patent application which he has bought and thus be able to prosecute it as may be most effective, even though the inventor be unavailable or unwilling to afford needed cooperation.

Simplification of patent procedure, independent of any effort of expediting it, is sought in another group of measures. Among these is one which is intended to prevent the difficulty now sometimes experienced in determining which one of several individuals of a group is the real inventor. Proposal would permit the joining of any number of persons who had had a part in the invention as members of the applicant group, and would prevent the complication which now results. The measure appears to have unanimous support and the bill incorporating the idea seems likely to pass.

A second simplification step proposes that an inventor should lose all right for demonstrating priority of invention beyond a period of two years prior to his application. It is argued that this requirement would speed up the application for patents and prevent the retention as secret processes of inventions which should not thus be withheld.

The requirement of only a single signature on an application for patents instead of the three now required at three different points in the papers is another improvement in technicality which is being urged.

A number of highly controversial modifications have been suggested but because of their very nature will probably not be acted upon at the present session.

Lubrication Subject Of Monographs

Beginning in April, Standard Oil Co. of Indiana will publish each month a technical monograph on lubrication of some type of equipment. The plan is to go through the whole line of the more important industrial units, making each lubrication discussion simple, brief and informative. No recommendations for any particular brands of lubricants will be made; the series will be simply an effort to give unbiased technical information. Requests should be addressed to the technical division, 910 S. Michigan Ave., Chicago.

A.S.T.M. Committees Meet in Cleveland

Committees of the A.S.T.M. held another in a series of annual Spring Group meetings in Cleveland at the Hotel Cleveland, March 7-11. The series of meetings, arranged for the convenience of committee members interested in the activities of more than one committee, was well attended with about 400 registered for the meeting. In all 20 main committees of the Society took part and held upward of 100 meetings during the five days. Several committees offered new standards some of which were mentioned in *American Machinist* last week.

The committee on Steel took action for the revision of various tentative specifications for fabricated pipe, including electric-resistance, electric-forge and electric-fusion-welded pipe and pipe sizes up to over 30 in. in diameter.

The subcommittee on Steel Reinforcement Bars also took action to authorize

the preparation of the methods of testing for wire and wire rope, drawing up specifications for alloy steel pipe for use in cracking steels for gasoline was referred to the committee for consideration through the Association of American Steel Manufacturers.

The subcommittee on Steel for Welding presented revisions as tentative in the standard specifications for steel plates of structural quality for forge welding and specifications for steel plates of flange quality for forge welding involving chemical compositions of plate material suitable for fusion welding.

Consideration is being given to the marking requirements of sheet or plates ¼ in. and less in thickness as the result of a request from the Boiler Code Committee of the A.S.M.E.

The subcommittee on valves, flanges and fittings for high-temperature service gave consideration to materials for use at temperatures above 750 deg. F. Present standard specifications for castings, pipe flanges and fittings, pipe and bolting materials contemplated temperatures up to 750 deg. F.

Inform-A-Show At Detroit

The 1932 Inform-A-Show of the National Association of Purchasing Agents will be held at the Book-Cadillac Hotel, Detroit, June 6 to 9. Some 50 companies have already taken space for the Show, which is managed from the offces of the Association at 11 Park Place, New York City.

Foundry Equipment Orders for February

February orders of the Foundry Equipment Manufacturers' Association showed a growth of 32.9 with cancellations of 5.3, giving net orders of 27.6. Shipments were 15.7 and unfilled orders 41.3. The three months' average of gross orders is 26.6. All these figures are on a basis of average monthly shipments for 1922-24 taken as 100.

New York N.A.C.A. Meets With A.M.A.

The National Association of Cost Accountants, New York Chapter, held a joint meeting with the New York group of American Management Association March 15 on the general subject: "Managerial Control of Sales Personnel and Expenses." T. M. McNiece, associated with Union Carbide Co., was the speaker of the meeting, and G. A. Willcockson, vice-president, Loose-Wiles Biscuit Co., led the discussion.

• BUSINESS ITEMS •

A new industrial X-ray laboratory has been established at 1349 Milwaukee Ave. E., by R. K. Welchli and L. L. Dickerson, for the X-ray examination of any objects of steel, iron, brass, wood, clay, or insulating material.

Reading Co. has awarded a contract to McClintic Marshall Co. for all steel to be used in the catenary structures to be erected in connection with electrification of two of its branches. The order is for almost 3,000 tons of steel.

One hundred additional workers have been added to the forces of the Ford plant at Cleveland. The Pennsylvania railroad added 50 men at Amityville, N. Y., and Norfolk & Western Railway added to its staff at Portsmouth, Ohio.

Kolster International Co. has added more than 100 employees to its working force in Newark. Manufacturing is in charge of S. T. Thompson, works manager.

Diamond Chain & Mfg. Co., Indianapolis, has appointed new West Coast representatives. Puget Sound Machinery Depot will represent the company in Oregon and Washington with stocks carried at Klamath Falls and Portland, Ore., and Hoquiam and Seattle, Wash. Joseph D. Christian Engineers of San Francisco have been made engineering representatives, and Horsford Brothers Co. of the same city, industrial distributor for Northern California. In the Los Angeles territory Goddard Jackson Co. is now Diamond Chain representative. Stocks will also be carried in San Francisco and Los Angeles.

Industrial Construction Corp., Ltd., 5125 Santa Fe Ave., Los Angeles, has taken over the complete line of the Shepard Niles Crane & Hoist Corp for Southern California, Arizona and parts of Nevada. W. W. McClung, formerly vice-president and production manager of the Union Iron Works, is president of Industrial Construction Corp. Ray E. Davies, vice-president, was formerly manager of the crane and hoist division of the Consolidated Steel Corp.

E. L. Essley Machinery Co., 551-557 Washington Blvd., Chicago, Ill., has been appointed exclusive selling agent in the Chicago, Milwaukee and Minneapolis territories for the full line of high-speed riveting hammers manufactured by High Speed Hammer Co., Rochester, N. Y.

Gilbert Howe Gleason & Co., Boston, Mass., has been appointed representative in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island, also part of Connecticut for Titusville Iron Works Co., Titusville, Pa., on a line of power and heating boilers.

York Aircraft, Ltd., with headquarters in Long Beach, Calif., has been organized to manufacture airplane engines. Directors include: Y. O. York, Ben S. Hunter, J. Belanger, G. Ray Boggs, and Arthur R. Burbee.

General Motors Corp. has purchased the outstanding 20 per cent minority interest in Adam Opel A.G., automobile manufacturer, in Germany, and now owns this property in its entirety. The amount paid has not been stated. It was indicated, however, in General Motors' annual report through the increase in General Motors' investment in Adam Opel A.G., from $25,966,705 to $34,667,708 during 1931, that the purchase price was at least $8,700,000.

Northrop Corp., Los Angeles, Calif., recently formed by officers of Douglas Aircraft Co. and founders of Northrup Aircraft Corp., Ltd., have taken a five-year lease on the former Moreland Aircraft factory adjoining Los Angeles Airport. A staff of engineers is now at work on a commercial plane. Officers are: President, John K. Northrop; vice-president and treasurer, W. K. Jay; and secretary, T. C. McMahon.

Champion Aircraft Corp. has taken over the former Emsco factory at Downey, Calif., and is building light training planes.

Lumen Bearing Co. has purchased at public auction the plant, equipment, supplies, etc., of Buffalo Bronze Die Cast Corp., which for several years past has been producing bronze and brass castings. The plant comprises a foundry, a machine shop, core room, and cleaning and snagging rooms, with much of the equipment designed for the production of special castings, such as certain types of worm gears.

William J. McBurney has been appointed receiver for Chelsea File Works, Inc., Greenwich, Conn.

• PERSONALS •

Albert E. Grover, of Berea, Ohio, has been named cost director of Gray Iron Institute, Inc., succeeding Charles E. Mitchell, resigned, according to an announcement by Arthur J. Tuscany of Cleveland, Institute manager. Mr. Grover will be in charge of cost work in the central and western area. The eastern cost work will be under the direction of Charles A. Klaus, Newark, N. J. For nearly four years Mr. Grover has been cost consultant for the National Machine Tool Builders' Association and has been identified with a number of prominent companies in the Cleveland area during his 26 years as a cost accountant.

E. T. Corbus, formerly first vice-president of Edgar T. Ward Sons Co., Pittsburgh, has been made president and treasurer of Uddeholm Co. of America, Inc., 342 Madison Ave., New York.

W. J. GIBNEY has been appointed vice-president, Chemung Foundry Corp., Elmira, N. Y.

C. R. HAMMER has been elected a director of McCord Radiator & Mfg. Co., Detroit, to succeed W. C. WINTER, resigned. L. M. HAMLIN has been elected treasurer to succeed Mr. Hammer.

Operating

GUY H. BILLINGS, for the past 17 years purchasing agent of Four Wheel Drive Auto Co., Clintonville, Wis., has been appointed assistant general manager. He will retain the title of purchasing agent as well. Mr. Billings has been with the company for 19 years, and joined it at a time when it was only 3 years old.

E. W. MORRELL, for the past 11 years in the manufacturing and distribution departments of National Radiator Corp., Johnstown, Pa., has been appointed purchasing agent.

HAROLD N. EWERTZ has been given complete charge of the welding department of Austin-Hastings Co., Inc., Cambridge, Mass.

ALFRED H. HOTOPP, JR., assistant engineer of Kolster Radio Corp. from 1928 to 1930, and later division engineer of Wired Radio, Inc., has been appointed engineer in charge of the receiver division of DeForrest Radio Co.

Sales

W. C. LYTLE, Evanston, Ill., has resigned from Pangborn Corp., Hagerstown, Md., with which he has been connected for 16 years, the last 10 years as district sales engineer in Chicago.

G. S. PETERSON, identified with the furnace department of Strong Carlisle & Hammond Co. for 12 years, is now engaged in industrial furnace engineering and contracting with offices at 1836 Euclid Ave., Cleveland, Ohio.

Activities

E. A. GATHMANN, president of the Gathmann Engineering Co., Baltimore, Md., spoke on "The Relation of Ingot Design to Quality Steel" at the March meeting of the New York Chapter of the A.S.S.T. on March 21.

ERNEST T. WEIR, chairman of the board, National Steel Corp., Pittsburgh, Pa., has been made Pennsylvania chairman of the American Legion's campaign to increase employment. H. B. RUST, president of Koppers Co., Pittsburgh, is one of the state sponsors of the campaign.

E. J. WALSH, vice-president and general manager of Chattanooga (Tenn.) Boiler & Tank Co., has been nominated by the Chattanooga Purchasing Agents Association for election to the vice-presidency of the N.A.P.A. for the fourth region.

• OBITUARIES •

WILLIAM L. AUSTIN, 77, former president and chairman of the board, Baldwin Locomotive Works, Eddystone, Pa., died at Rosemont, Pa., Mar. 11. He had been associated with Baldwin for 60 years prior to his resignation in 1930. He was a director of Baldwin and also of Standard Steel Works Co., Burnham, Pa. He entered the employ of Baldwin in 1870 and served successively as draftsman, designer, engineer and vice-president, becoming president in 1910 and chairman of the board in 1911.

FRANK G. BAUM, 58, nationally known consulting engineer and chief engineer for Pacific Gas & Electric Co. for many years, died in Redding, Cal., March 14, from injuries suffered in an accidental fall from a hotel roof while he was inspecting newly installed equipment.

JOHN T. CLANCY, 42, executive of Worthington Pump & Machinery Corp., Harrison, N. J., died suddenly of a heart attack March 9, while lecturing at the Engineers' Club, New York City, before a meeting of the American Society of Mechanical Engineers. In 1919 he joined Worthington and in 1923 became assistant manager of oil and gas engine sales, with headquarters at Buffalo, N. Y., the position he held until his death. In July, 1931, his headquarters were moved to the Harrison (N. J.) plant.

GEORGE EASTMAN, 71, founder and chairman of the board of Eastman Kodak Co., internationally known philanthropist and inventor, and master of mass-production before the automobile plants adopted it, committed suicide March 14 in Rochester, N. Y.

LEWIS WILLIAM HEMP, 95, president of Hemp & Co., 1939 South Vandeventer Ave., St. Louis, Mo., manufacturers of heaters and other sheet-metal products, died there March 7.

CHARLES E. HORTON, 51, owner of Chicago (Ill.) Aluminum Castings Co., died March 15 there.

JACOB KASTLIN, 76, former vice-president and general manager of Davenport (Iowa) Locomotive Works, died unexpectedly the morning of Mar. 6 at his home there. He came to Davenport in 1905 as superintendent of Davenport Locomotive Works and later became vice-president and general manager, returning to Philadelphia in 1916-19 as superintendent of Baldwin Locomotive Works munition plant, and returning to Davenport again in 1919. He retired in 1923.

JOHN T. MCEVOY, 60, member of the firm of M. & T. Tool Co., Cincinnati, Ohio, died there Mar. 12.

GEORGE NICHOLSON, 62, vice-president and assistant general manager of Vulcan Iron Works, Wilkes-Barre, Pa., died there March 15. He had joined Vulcan at 18 with his father and his brother, SAMUEL T., who is now president.

MICHAEL J. NOWAK, 62, founder and principal executive of Star Plating Co., Buffalo, died Mar. 9 following a heart attack.

JOHN MORRIS SELLERS, 66, president of Sellers Mfg. Co., makers of railway supplies, Chicago, died March 14 at his home there.

MINOR B. STEWART, 48, vice-president of Hammond Iron Works, Warren, Pa., died recently.

BERNARD THOLE, 50, Cincinnati district manager of Pittsburgh Water Heater Co., died in Cincinnati, Mar. 11.

FRANK A. WALSH, 84, pioneer inventor and manufacturer of machinery for making tin cans and other containers, died at his home in Milwaukee Mar. 5. He had retired about 25 years ago.

WALTER W. WESSLING, 44, with Kruse Hardware Co. for 28 years, and a director for several years died at Cincinnati Mar. 11.

HORACE E. WHITNEY, 59, head of Dover Stamping & Mfg. Co., Cambridge, Mass., died recently at his home there.

• MEETINGS •

AMERICAN WELDING SOCIETY
Annual meeting, Engineering Societies Bldg., New York, Apr. 27-29. William T. Spraragen, secretary, 29 W. 39th St., New York City.

FOUNDRY AND INDUSTRIAL EXPOSITION
Also 36th annual convention, American Foundrymen's Ass'n, Hotel Statler, Detroit, Mich., May 3-5. C. E. Hoyt, manager, American Foundrymen's Ass'n, Inc., 222 W. Adams St., Chicago.

AMERICAN GEAR MANUFACTURERS ASS'N
Sixteenth Annual Meeting, Hotel Statler, Cleveland, Ohio, May 12-13. Executive Committee meeting, same place, May 11. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS
Annual meeting, Atlantic City, June 20-24. R. E. Hess, assistant secretary, 1315 Spruce St., Philadelphia, Pa.

NATIONAL MACHINE TOOL BUILDER'S ASS'N
Third National Machine Tool Show, Cleveland (Ohio) Municipal Auditorium, Sept. 10-17. Boyd Fisher, general manager, 1415 Enquirer Bldg., 617 Vine St., Cincinnati, Ohio.

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Opportunities for Future Business

Calif., Alameda—Constructing Quartermaster, Washington, D. C., having plans prepared for construction of a 1 story, 330 x 380 ft. shop building at Benton Air Field, here.

Ind., Kokomo—Lincoln Oil Co., awarded general contract for construction of a service station at Washington St. and Boulevard Ave. Estimated cost $40,000.

Ind., Lafayette — Purdue University, R. B. Stewart, Controller, will receive bids until April 5 for unit 2 of mechanical engineering building, 3 story, 60 x 230 ft. Estimated cost $200,000. Walter Scholer, 210 Wallace Bldg., Archt. Noted February 11.

La., Harvey—Continental Can Co., 1 Pershing Sq., awarded contract for construction of a 3 story, 120 x 160 ft. can manufacturing plant here. Estimated cost $125,000. Favrot & Livaudais, Hibernia Bldg., New Orleans, Archts. Noted February 11.

La., Shreveport—Constructing Quartermaster, War Dept., plans construction of thirty noncommissioned officers' quarters, officers' quarters, completion of hospital, garage, and warehouse at Barksdale field. $1,380,000.

Me., Portland—Cushman Baking Co., 107 Elm St., having plans prepared for construction of a 2 story garage on Lancaster St. Estimated cost $40,000. Webster & Libby, 443 Congress St., Archts.

Md., Baltimore—J. F. Lowrey & Sons, 826 West Baltimore St., manufacturers of plumbing equipment and supplies, awarded contract for a 1 story shop.

Mass., Boston—School Committee, 15 Beacon St., plans construction of a 2 story annex to mechanical arts high school. Estimated cost $250,000 to $275,000. Architect not selected.

Mass., Northampton—Clarke School for the Deaf, Round Hill, awarded contract for construction of boys' and girls' work shop buildings. Noted March 3.

Mass., Quincy (Boston P. O.)—Standard Oil Co. of New York, Park Sq. Bldg., Boston, will receive bids until March 31 for construction of garage, office building, docks, tanks, etc., at Town River an Washington St. here. Estimated cost $1,000,000. R. H. Morse, c/o owner, Engr. Noted December 3.

Mich., Detroit—Motor & Machinery Castings Co., 7742 West Davison St., awarded contract for a 1 story addition to foundry. Estimated cost to exceed $25,000.

Miss., Fernwood — Indianapolis Wire Bound Box Co., 1300 Beecher St., Indianapolis, Ind., will soon receive bids for construction of a 1 story, 150 x 200 ft. plant here. Estimated cost $50,000.

Miss., Hattiesburg — Enterprise Machine & Foundry Co., plans reconstruction of shops recently destroyed by fire. $35,000.

Neb., Lincoln—State Board of Control, H. S. Thorpe, Chn., awarded contract for structural steel, etc., for 1 story, 50 x 120 ft. building to be used for making license plates at Boys State Reformatory. Noted January 14.

N. J., Eatontown—William Champlin, 6 Hunt St., Rumson, plans construction of a 1 story addition to garage and repair shop here. Architect not announced. Maturity soon.

N. J., Newark—Alling Corp., 33 Ward St., having plans prepared for construction of a 1 story garage at 36-42 Columbia St. Estimated cost $40,000. William E. Lehman, 972 Broad St., Archt.

N. J., Newark—Thomas J. Lee, Inc., 495 Lyons Ave., manufacturers of plumbing equipment and supplies, plans completed for a 2 story, 50 x 200 ft. pipe shop and storage and distributing building. Estimated cost $50,000. N. J. Convery, 32 Walnut St., Newark, Archt.

N. Y., Brooklyn—Epstein & Schoor, 4th Ave. and Third St., having sketches made for construction of a 40 x 100 ft. service garage. W. C. Lacerenza, 16 Court St., Archt.

N. Y., Brooklyn—Ferndale Farms, 219 Liberty Ave., awarded contract for construction of a 1 story, 35 x 100 ft. service garage, also storage building and platforms at Snediker and Liberty Aves. Noted March 10.

N. Y., Far Rockaway—Charles Kosotan, 600 Beach 25th St., plans construction of a 2 story, 26 x 42 ft. garage and shop at Deckers Ave. and Beach 25th St. A. Kornblum Co., c/o owner, Archt.

N. Y., Flushing—G. Di Gerolamo, 13 West Bradford Ave., having sketches made for construction of a 100 x 125 ft. service garage at James St. and 41st Ave. P. L. Kieswetter, c/o owner, Archt.

N. Y., Jamaica—Queens County Service Station 182nd St. and Hillside Ave., plans construction of a 1 story, 42 x 84 ft. addition to repair and service garage. A. Goldberg, 164 Montague St., Brooklyn, Archt.

N. Y., New York—Carlonesto Realty Corp., 391 East 149th St., having sketches made for construction of a 1 story, 65 x 130 ft. service garage and automobile laundry at Jerome Ave. and Kingsbridge Road. M. W. Del Gaudio, 545 5th Ave., Archt.

N. Y., New York—Consolidated Gas Co., 4 Irving Pl., plans a 6 story addition to shop and storage building at 120 Amsterdam Ave. J. F. Hunter, c/o owner, Archt.

N. Y., New York—Emaron Realty Corp., c/o M. W. Del Gaudio, 545 5th Ave., awarded contract for construction of a garage building at 17 to 19 Le Roy St. Estimated cost $150,000.

N. Y., New York—Fred Kannew Inc., 700 11th Ave., lessee, plans demolition of existing buildings and erecting gasoline, servicing and repair facilities on site at Canal and Houston Sts. Estimated cost to exceed $40,000.

N. Y., Richmond Hill—William E. Goetter, 9825 Jamaica Ave., having preliminary plans for a 2 story, 112 x 311 ft. addition to garage and shop at Jamaica and 87th Aves. H. H. Holler, c/o owner, Archt.

Pa., Lancaster—L. O. Beard Tool Co., East Marion St., manufactures of machine tools, etc., plans to rebuild part of plant recently destroyed by fire.

Pa., Lemoyne—Lemoyne Quarries Co., plans to rebuild tool shop, crusher and powder unit destroyed by fire. $25,000.

Pa., Pittsburgh—Buhl Foundation, Charles E. Lewis, Dir., Farmers Bank Bldg., awarded general contract for construction of a garage and stores building at Bingham St. and Sulgrave Road. Estimated cost $100,000. Noted March 10.

Tex., Corpus Christi — John Remonte, plans construction of a plant for the manufacture of refrigerators, operated by electricity, natural gas and kerosene.

Tex., Houston—Continental Can Co., Pershing Sq., New York, N. Y., plans construction of a can manufacturing plant here. Estimated cost to exceed $40,000. Favrot & Livaudais, Hibernia Bldg., New Orleans, La., Archts.

Wis., Plymouth — Board of Education, will soon award contract for construction of a new junior and senior high school including vocational shops, etc. Estimated cost $250,000. H. W. Tullgren, 1234 North Prospect Ave., Milwaukee, Archt. Noted August 20, 1931.

N. S., Baddock—North American Gypsum Co. Ltd., having plans prepared for construction of a gypsum plant. Estimated cost $150,000. Private plans. Noted October 29.

Ont., Thorold—McColl-Frontenac Oil Co., 114 Don Esplanade, Toronto, plans construction of a gasoline and oil storage plant 3,500,000 m.g.p.d. including warehouse and garage here. Estimated cost $65,000.

Que., Montreal—City Executive approved construction of garage on Champ de Mars. Estimated cost $1,000,000. Actual construction depends on whether the Provincial and Dominion governments will regard same as a relief measure. Noted March 3.

Que., Three Rivers—Canada Iron Foundries Ltd., having plans prepared for construction of a plant for the manufacture of water pipe valves. Estimated cost $100,000. Maturity in spring. Noted March 10.

Greece, Piraeus — Ford Motor Co., Schafer Road, Dearborn, Mich., has been granted permit by Greek government to construct an automobile manufacturing and assembly plant here.

Equipment Wanted

Calif., Mare Island (sta. Vallejo)—Bureau of Yards & Docks, Navy Department, Washington, D. C.—will receive bids until April 5 for two motor driven screw cutting lathes. Sch. 7732.

Colo., Fort Logan — Division of Purchase, Sales & Traffic, Department of Agriculture, Washington, D. C.—will receive bids until March 29 for portable pneumatic drill sharpener here.

D. C., Washington—General Purchasing Officer of the Panama Canal—will receive bids until March 29 for electric welding outfit. Sch. 2739.

D. C., Washington—Veterans Administration, Procurement Division—will receive bids until March 31 for motor driven woodworking machine for Veterans' Hospital, Cir. 413-M.

Mo., St. Louis—J. Becker, 3513A South Jefferson Ave.—9 to 14 in. screw cutting lathe.

Ont., Wallaceburg—Schultz Die Casting Co. of Canada, C. Gordon, Mgr., A. St.—additional machinery and equipment for the manufacture of die casting equipment for recently acquired premises.

Que., Montreal — City, A. Nickle, Supt. of Purchases—drill sharpener, oil furnace and stationary compressor.

N. Z., Wellington—New Zealand Government Railways—will receive bids until June 2 for butt and arc welding sets suitable for use in 200 v. 50 period single phase supply; 15 ton electrically operated overhead traveling crane; engine lathe, spindle grinder and three portable drilling machines, radial and non radial.